Volume 27 MAY, 1921 Number 9

MACHINERY

THE INDUSTRIAL PRESS Publishers, 140-148 LAFAYETTE ST., NEW YORK

VOLUME 27 **MACHINERY** NUMBER 9

MAY, 1921

THE INDUSTRIAL PRESS, 140-148 LAFAYETTE ST., NEW YORK CITY

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Published monthly. Yearly subscription in United States and territories $3, plus $1 Zone postage west of Mississippi and in Alaska, Hawaii, Philippines, Porto Rico, Canal Zone, Cuba and Mexico; Canada, $4.50; foreign countries, $6; single copies, 35 cents, postage extra. A subscription is acknowledged by sending the current number. Checks and money orders should be made payable to THE INDUSTRIAL PRESS.

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Circulation for April, 1921, 23,750 Copies

Member Audit Bureau of Circulations

Entered as second-class mail matter, September, 1894, at the Post Office, in New York, N.Y., under the Act of March 3, 1879. It is understood that all contributed articles pertaining to machine shop practice and machine design are submitted exclusively to MACHINERY; when accepted and published, payment is made at our regular space rates unless other terms have been agreed upon.

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The Editor's Monthly Talk

THE automobile industry, following several months of an almost complete shut-down, has passed through the worst of the crisis, and after readjustment to new conditions will emerge stronger and safer, occupying a more conservative position in the industries and being less subject to spectacular fluctuations.

The development of special machines, tools, and fixtures has become an essential part of automobile manufacturing practice. In automobile plants, where interchangeable manufacturing can be developed to the highest degree, the use of tools designed to perform a variety of operations not only reduces manufacturing costs, but also simplifies the whole problem of making duplicate interchangeable parts, because equipment designed for one kind of work only may have non-adjustable parts, fixed locating points, and other features not within the control of the operator, and hence is independent of the human element. This results in greater precision, because it places the quality of the product upon a mechanical, and therefore a more dependable, basis.

The leading article in May MACHINERY describes and illustrates a number of special devices used at the plant of the H. H. Franklin Mfg. Co., Syracuse, N. Y., where the well-known Franklin car with its air-cooled engine is made. The examples of tools and equipment shown in this article represent principles in tool design applicable to other machine building plants that work on the interchangeable manufacturing plan.

Efficiency Factors in Production Planing

To obtain maximum output in the operation of machine tools, a careful study of all the conditions which affect production is necessary. The planer department presents problems that are no exception to this general rule. In the setting up and planing of work, particularly in the shops that are on a production rather than a jobbing basis, there are a great many points to be taken into consideration. These points may be designated as "efficiency factors," because they determine the rate of output and the consequent labor and overhead cost. The article on "Production Planing in Machine Tool Plants," in May MACHINERY, deals extensively with these factors and points out how maximum output may be obtained in planer operation by the observation of principles that experience has taught to be fundamental. This article will be continued in the June number.

Coming Articles in June MACHINERY

There are certain operations in metal-working which cannot be economically performed, if at all, by any other method than by swaging—the uniform rapid hammering of metal to change its shape—which may be performed either on hot or cold metals. In June MACHINERY, an article dealing with cold swaging methods will be published, which points out the possibilities of the application of swaging and its effect upon the quality of the metal, and contains a detailed description of the methods of making swaging dies. Practically every known metal can be successfully swaged, including not only steel, copper, and brass, but also such materials as tungsten and monel metal. It is not generally known that screw threads can be produced by swaging, but this is successfully and satisfactorily done. The characteristic of a swaged thread is its accuracy in lead rather than in thread form. Swaging is also the only process by which gold-plated base metal rods can be reduced in diameter from, say, 1/2 inch to the very small sizes extensively used in the optical and jewelry trades, without losing, as it is swaged into a fine wire, the protective quality of the thin gold covering or plating originally given to it.

A Successful Inspection System

In May MACHINERY, there is an article on "Principles of Inspection." In the June number this will be followed by an article on "The Delco Inspection System," which describes the methods used by the Dayton Engineering Laboratories Co., Dayton, Ohio, for the rational inspection of raw materials, purchased parts, tools, equipment, and gages, as well as of the manufactured product. There are many interesting features in this inspection system not generally known in the machine building industry, and the article will therefore prove of exceptional interest to mechanical men responsible for production and inspection. One of the methods peculiar to the Delco plant is the so-called "night tool inspection" described in this article. A tool inspector visits the various manufacturing departments after the closing hours and inspects all the gages that have been used during the day. In this way, it is possible to maintain the gaging equipment in first-class condition at all times. It insures the accuracy of the gages, saves a great deal of poor work, eliminates arguments with the men that their gages are incorrect, and therefore not only increases production but also creates a better spirit in the plant.

Among other articles of especial interest in the June number of MACHINERY, will be one on Milling Slender Castings, showing methods used for obtaining accuracy in machining parts of this kind where the springing action in the metal would be likely to cause difficulties.

Special Machines and Fixtures in the Franklin Plant

Mechanical Equipment Designed Either to Increase Production, Perform Special Operations, or Maintain Established Standards of Accuracy

By FRANKLIN D. JONES

AT the plant of the H. H. Franklin Mfg. Co., Syracuse, N. Y., where the well-known air-cooled Franklin car is made, a considerable variety of special tool equipment is used in different departments. A number of these special devices are described and illustrated in this article, as they represent certain principles in tool design that can be applied in other machine-building plants producing interchangeable parts on a large enough scale to warrant the expense of special equipment. These devices are utilized for a wide variety of purposes and in different departments of the Franklin plant, so that no attempt will be made to present them in logical order, because the operations in many cases are entirely unrelated.

Nut-driving Machines

The work of assembling the motor and certain other parts of an automobile requires the screwing on and tightening of a large number of nuts. This is time-consuming work when done by hand, and at the Franklin plant nut-driving is done mechanically. The machines used for this purpose operate on the same principle, but differ in regard to their general arrangement and the method of manipulating the nut-driving spindle. The latest design installed in the Franklin plant is illustrated in Fig. 1. The spindle of this machine runs at a speed of nearly 1000 revolutions per minute, and yet, notwithstanding this high speed, the socket wrench at the lower end of the spindle will instantly drop on a nut without marring it, drive it home, and if necessary, loosen it and back it off the bolt. As soon as the wrench of the machine engages the nut, the latter is screwed on the stud and tightened with surprising rapidity.

The development of special machines, tools, and fixtures has become an essential part of automobile manufacturing practice. The use of tools designed to perform a single operation as efficiently as possible not only reduces manufacturing costs greatly, but also simplifies the making of duplicate parts accurately, since equipment designed particularly for one kind of work may have non-adjustable members, fixed locating points, or other features all tending toward greater precision, thus placing the quality of the product upon a mechanical and more dependable basis.

The machine is driven by an air motor *A*, which revolves spline shaft *B* through spur gears. Shaft *B*, in turn, transmits motion to the vertical spindle *C* through spiral gears. Between this vertical spindle and the nut-driving end, there is a friction clutch which can be adjusted so that it will slip whenever the nuts have been tightened sufficiently. By means of this clutch, each nut is automatically subjected to the same pressure or torque, and the machine can also be adjusted for driving nuts of different sizes. Below the friction clutch there is a positive two-jaw clutch through which the nut wrench is driven. When the machine is running idly, the nut wrench at the lower end of the spindle hangs free, and would remain stationary if gripped by the hand. When the spindle is lowered by hand-lever *D*, the upper half of the positive clutch engages the lower one, and the wrench, which is already resting on the nut, at the first touch of the upper clutch member, drops on the nut.

One of the ingenious features of this machine is that part of the mechanism which comes into action when it is necessary to back a nut off after tightening it. When a tightened nut is to be removed, more power is required at the instant of starting it backward than at any time while driving the nut on; consequently, additional tension must be applied to the friction clutch to keep it from slipping and thus prevent the machine from loosening the nut. This additional tension is provided automatically by a

simple arrangement, consisting chiefly of a spring and an auxiliary clutch, each member of which has three jaws of spiral or helical form. These teeth are so shaped that the two clutch members are positively locked when driving a nut forward, but if the spindle is reversed when the lower section is retarded by a tightened nut, the spiral clutch teeth slide up upon one another against the tension of the spring which normally holds them in engagement. As the result of this expansion of the two clutch members, the spring is compressed and this extra compression subjects the friction clutch to additional pressure so that it will transmit enough power for starting the tightened nut backward at the instant of reversal.

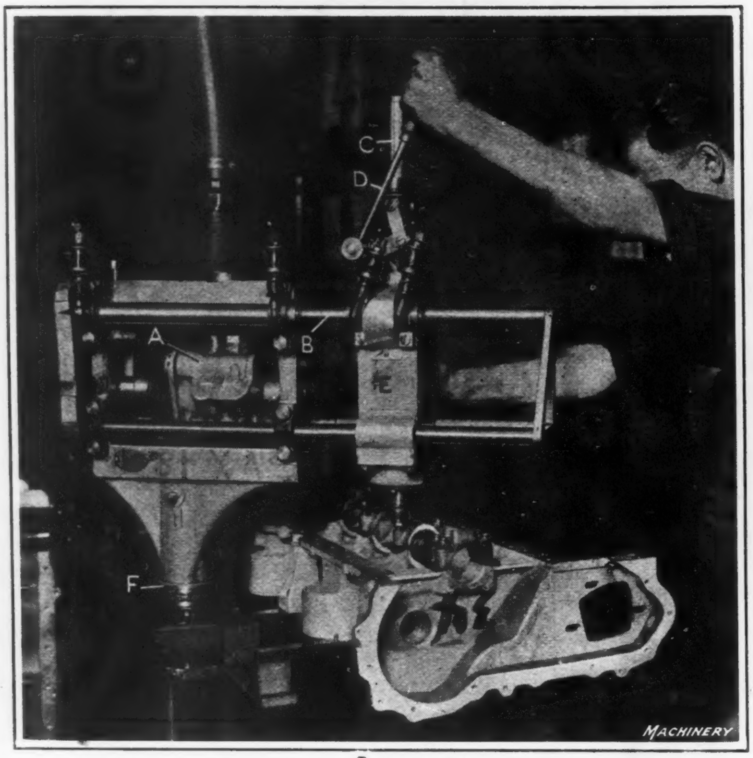


Fig. 1. Brown Nut-driving Machine with Radial Adjustment

When the machine is in use, the spindle is manipulated vertically by lever *D*, which the workman seen in the illustration is holding with his left hand, while he moves the entire head *E* in or out along its three guide rods with his right hand, which grasps a suitable handle on the opposite side from that shown. In addition, the entire machine is free to swing about a vertical axis, and a ball thrust bearing is provided at *F* to give a free easy swinging movement. This machine is the invention of Spencer Brown who has developed a number of other time- and labor-saving devices for use in the Franklin plant.

Another design of nut-driving machine operating on the same general principle as the one described is used on classes of work not requiring radial or swinging adjustments, and the vertical movement of the nut-driving spindle is controlled by a foot-lever instead of a hand-lever. One of these machines operates at a speed of 1300 revolutions per minute, and notwithstanding this high speed, the wrench readily engages the nut and drives it home. On all of these machines, as soon as the nut is tightened and the spindle is raised either by a foot- or a hand-lever, according to the design, the positive clutch, which (as described in connection with the machine shown in Fig. 1) connects with the nut wrench, disengages so that the wrench hangs free and is simply lifted off the nut as the spindle moves upward.

Still another design of nut-driver that is extensively used in the assembling departments is shown in Figs. 2 and 3. This design is also driven by an air motor. The motor is suspended from an overhead track which enables the workmen to move the machine easily from one point to another. The framework supporting the motor (see Fig. 3) is pivoted to the end of a counterweighted lever (not shown) which balances the weight of the motor and driving mechanism and enables the workmen to easily manipulate the nut-driving end. The motor frame is supported by trunnions, and the motor itself has trunnion bearings located at right

Fig. 2. Example of Work for which Overhead Type of Nut-driving Machine is adapted

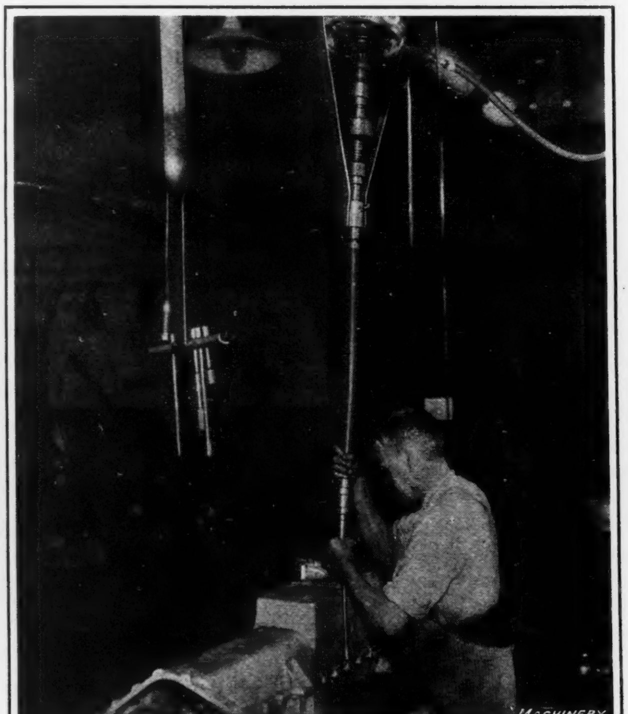


Fig. 3. Nut-driving Machine of Overhead Type with Flexible Shaft Drive

angles to the frame bearings to give a universal movement. The drive is through an adjustable friction clutch which slips when the nut is tightened properly, the arrangement being practically the same as previously described. A flexible shaft connects the motor with the nut-driving end. This flexible shaft is needed when driving nuts which require holding the nut wrench in different positions, as when assembling the combination fan and flywheel shown in Fig. 2.

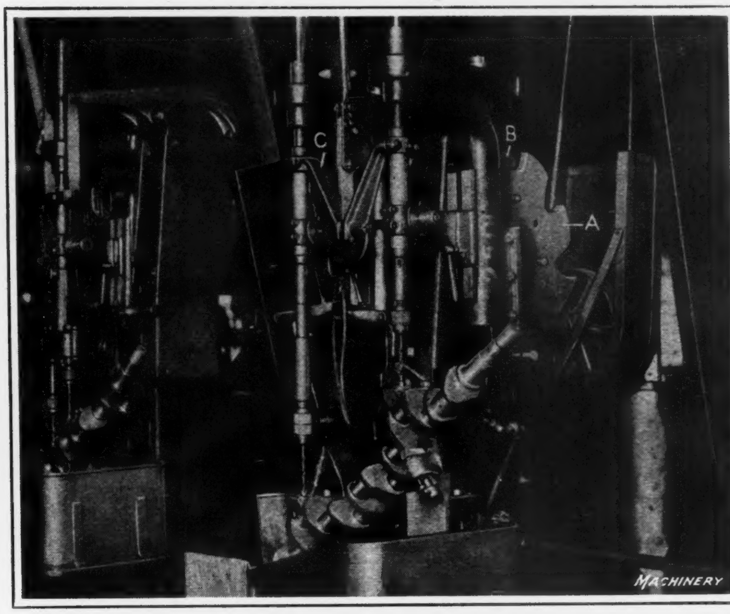


Fig. 4. Special Machines for drilling Crankshaft Oil-holes

Spring Testing Fixtures

The valve springs of a Franklin motor are tested after heat-treatment to determine whether they exert the required pressure when compressed to a certain specified length. The apparatus used for this purpose is shown in Fig. 5. The first operation after heat-treatment is to set the springs, which is done by compressing them with the press seen at the left. An arbor press has been adapted for this work by attaching to the pinion-shaft a drum or pulley connecting with a belt which passes over an idler pulley and is attached at the lower end to a foot-lever. When the spring is compressed by forcing the foot-lever downward, the ram of the press is returned by the spring at the upper end. After this setting operation, the pressure exerted by each spring when compressed to the standard length is determined by the apparatus shown in use in the illustration. The springs must exert a pressure of from 25 to 30 pounds when compressed to a length of 1¾ inches. When a spring has been compressed to this length by turning a hand-lever which, through a pinion and rack forces the plunger downward, an electrical contact point attached to this plunger engages a fixed point, thus closing a circuit and lighting the electric lamp seen at the top of the fixture. Then the workman glances at the dial of the scale, which shows whether the pressure is within the prescribed limits.

Another spring-testing fixture which operates on the same principle as the one just described is shown in Fig. 6. This fixture is used for testing the clutch springs. It has the electrical contacts and light, the same as the valve spring fixture, but a handwheel is used for compressing the spring, which is quite long when fully extended and requires a comparatively large movement of the compressing member. These springs, when forced down to the height shown in the illustration, must exert a pressure of about 230 pounds; this is the spring which normally holds the clutch members of the car in contact.

Special Machines for Drilling Oil-holes in Crankshafts

The oiling system of the Franklin motor is of the force-feed recirculating type, with a separate lead to each bearing. The path followed by the oil is from the oil reservoir to the pump, then through the oil-leads to the main bearings, then through the crankshaft to the connecting-rod bearings, and off the sides of the connecting-rods to the camshaft, cylinders, and wrist-pins. The flow of oil from the main bearings of the crankshaft to the crankpins is

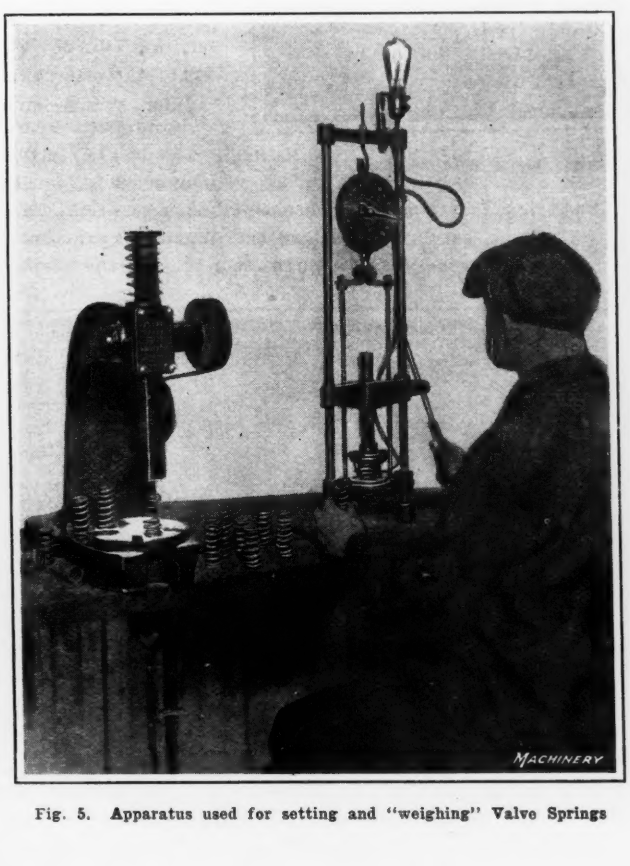


Fig. 5. Apparatus used for setting and "weighing" Valve Springs

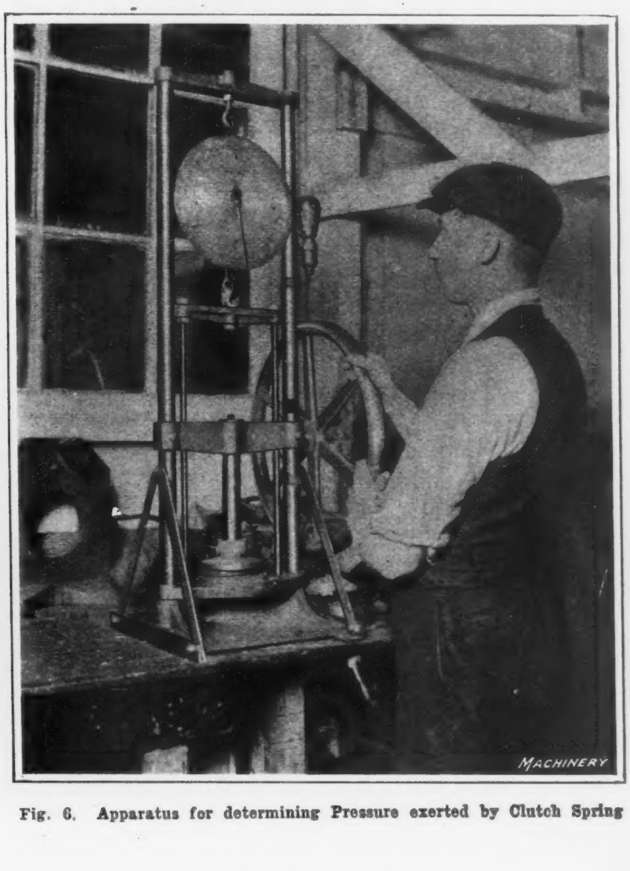


Fig. 6. Apparatus for determining Pressure exerted by Clutch Spring

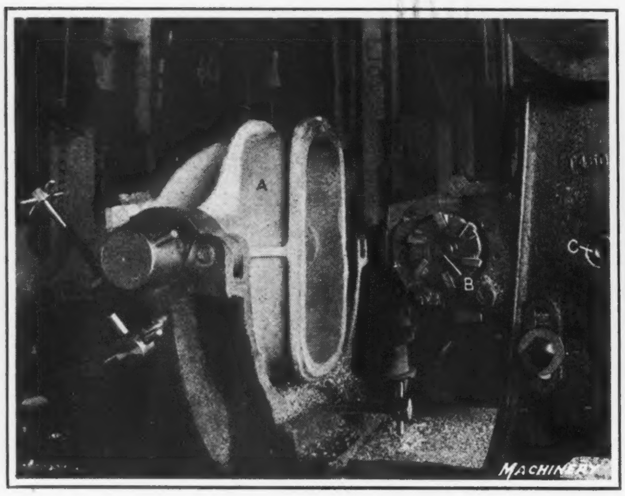


Fig. 7. Differential Housing and Special Attachment for Internal Milling

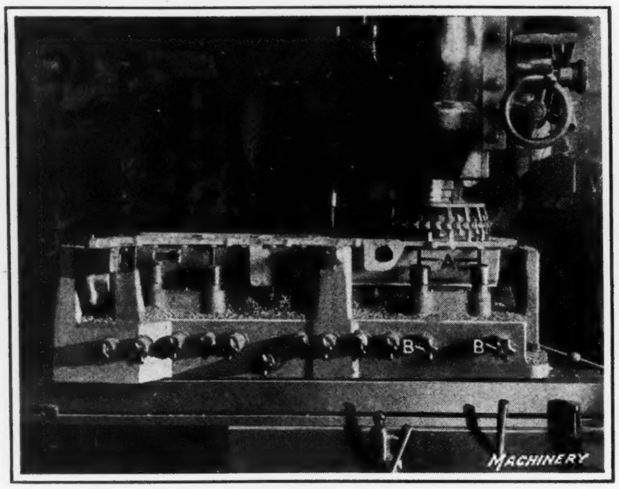


Fig. 8. Fixture used in performing Face-milling Operation on Engine Base

through holes which are drilled by machines equipped with special attachments for automatically backing out the drills at intervals to prevent the chips from clogging and breaking them. Two of these machines are shown in Fig. 4.

The progressive feeding and reversing movements are derived from cam *A*, which has several lobes for controlling the forward and backward motions. This cam engages a roller on lever *B*, which is pivoted in the center and connected at the opposite end through links with yoke *C*. The outer ends of this yoke are secured to the drill spindle sleeves or quills. The total vertical movement of the spindle necessary for drilling a hole is about 2¼ inches, and when a hole is being drilled, the spindle and drill are withdrawn four times to clear the hole of chips. When the hole has been drilled half way through the crankpin, the web, and the main bearing, the machine is stopped automatically by a trip at the rear, which engages and releases a latch, thus allowing the belt to be shifted to a loose pulley by the action of a spring. The crankshaft is then reversed in the fixture and the other half of the hole drilled, the two holes meeting in the center of the web. The crankshaft is held at an angle of about 37 degrees for this operation in the fixture shown in the illustration. The six oil-holes in each crankshaft are drilled on three separate machines, each having two spindles located at different center-to-center distances, depending on the spacing of the bearings.

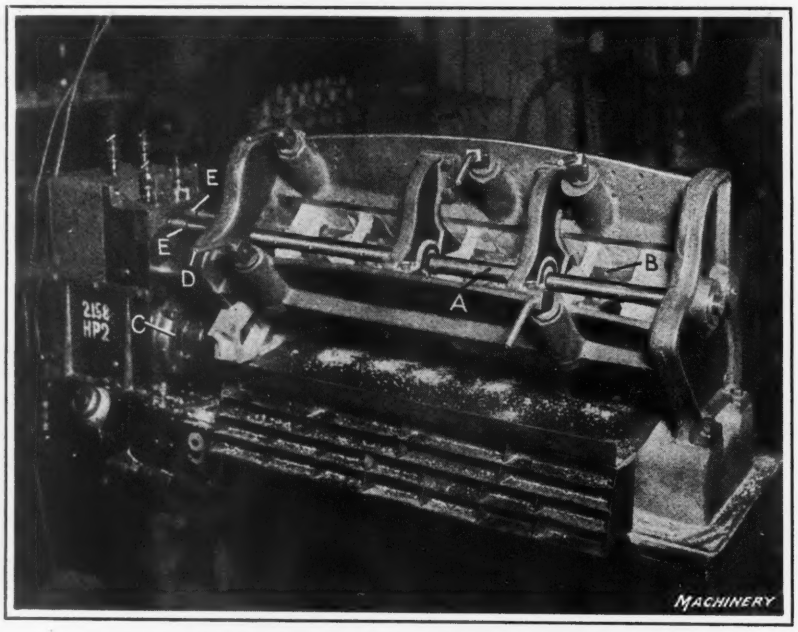


Fig. 9. Double-spindle Machine for boring Engine Base Bearings

Milling Attachments and Fixtures

A special attachment used for milling ball bearing seats in the differential housings is shown in Fig. 7. This seat is well within the housing *A*, so that it is necessary to use an attachment which is in the form of

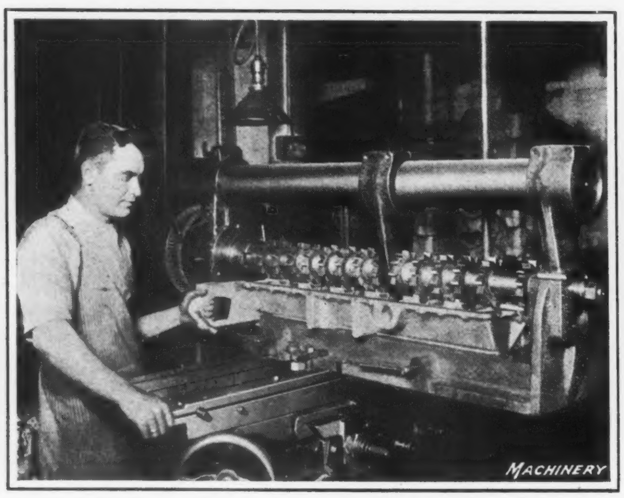


Fig. 10. Milling Ends of Engine Base Bearings

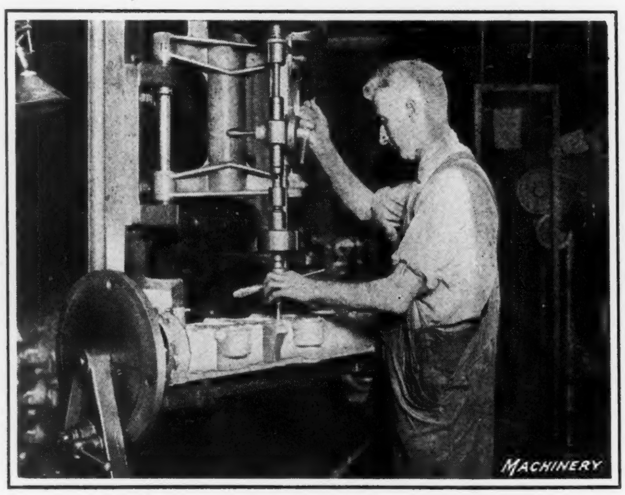


Fig. 11. Tapping Holes in Engine Base

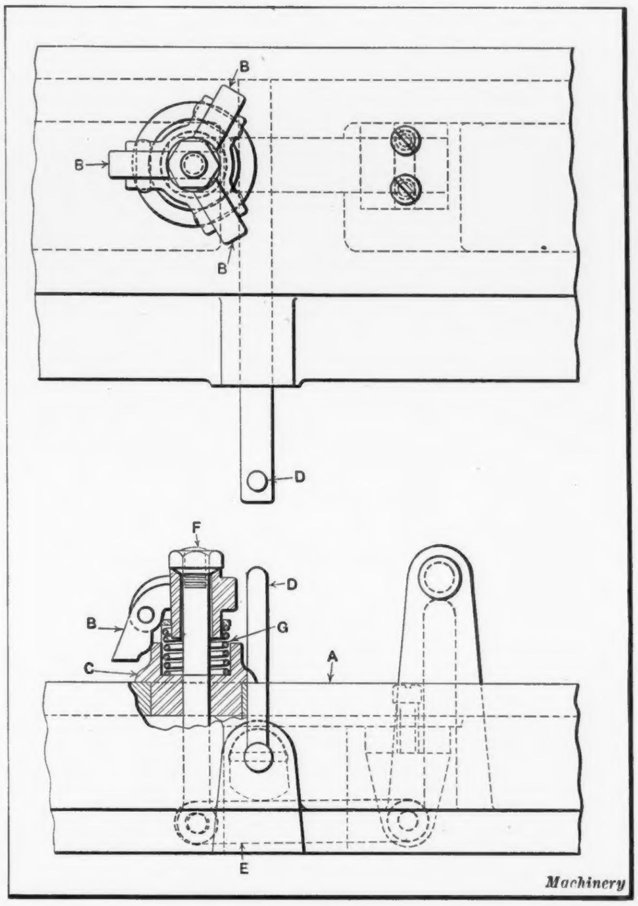


Fig. 12. Expanding Type of Clamp used on Engine Base Fixture shown in Fig. 10

an arm that carries at its end the two cutters and is long enough and narrow enough to reach within the housing. The end of this arm is shown in the illustration. The arbor *B* carrying the two cutters is driven from spindle *C* connecting with the main spindle, through three spur gears. Another internal facing attachment similar to the one described is used for milling certain interior surfaces on the transmission case.

A face-milling operation on the engine base casting is shown in Fig. 8. This is an aluminum alloy casting, and the bottom face is first milled on the vertical-spindle machine shown in this illustration. The fixture used is designed to hold the casting firmly by means of contact points engaging the rough surfaces. There are a number of these contact or locating points (like those shown at *A*) in the form of rods which are provided with springs that tend to push them upward; consequently, when the casting is placed in the fixture, all these spring-supported rods are held up into contact with it, and then they are locked in position by turning locking screws. The two locking screws for rods *A* are shown at *B*. Some of these screws lock the rods on the rear side. With this arrangement the contact points automatically adjust themselves to compensate for slight irregularities in the casting, which is firmly supported against the downward thrust of the milling cutter.

The fourteen sides of the seven main bearings of the engine base are all milled at one time by a gang of fourteen cutters arranged as shown in Fig. 10. The fixture used for this casting has two clamping devices of interesting design, arranged as shown in Fig. 12, which is a detail view of one of the clamps. The milled face of the casting rests upon the surface *A* of the fixture, and the three equally spaced clamping members *B* extend up through a circular opening in the casting and are tightened or released by levers *D*. When this lever is turned, a cam surface forces pivoted link *E* and bolt *F* downward; then cam surfaces on the lower sides of the three pivoted fingers *B* of each clamp engage the curved flange of part *C* and are forced outward far enough to grip the casting. When lever *D* is turned in the opposite direction, bolt *F* and the pivoted clamps are forced upward by spring *G*; then the fingers move inward far enough to pass through the hole as the casting is lifted up off the fixture.

Special Boring Machines for Engine Bases

The main-line and camshaft bearings in the engine base are bored by special machines designed exclusively for this work. One of the machines used for the first boring operation is illustrated in Fig. 9. This machine bores the camshaft bearings and the semicircular seats in the casting that receive the linings of the main crankshaft bearings. There are two boring-bars *A* and *B*, which are driven from a motor *C* through suitable reduction gearing. Bar *A* is for the main bearing seats and bar *B* for the camshaft bearings. These bars are supported by four bearings in the heavy frame of the machine, which serves as a fixture for locating and holding the casting. The milled face of the work is clamped against the under side of the fixture, and the work is located by two stops which engage the side of the casting at each end. These stops are held in the locating position by a form of bayonet lock, and by turning them a small part of a revolution they are forced by springs back out of the way, so that the casting can readily be inserted in or removed from the fixture. The five clamps for holding the casting in position are in the form of hook-bolts which are drawn up against the casting flange by eccentric levers *D*. Each bar passes through a threaded sleeve at *E*. These sleeves are revolved at a slower rate than the bars, and provide the feeding movement when engaged by segments of nuts which are controlled by small hand-levers. The boring operation on this machine requires only four minutes of actual cutting time.

The final operation on the main-line bearings of the engine base is illustrated in Fig. 13, and takes place after the linings and caps are assembled. This machine is of the same general design as the one illustrated in Fig. 9, except that it has a single boring-bar. The casting in this case is located by the milled face and by plugs, which enter the bored camshaft holes.

Tapping and Drilling Fixtures

When the engine base and oil tank are assembled, there is a short Acme thread in the main-bearing seat at one end.

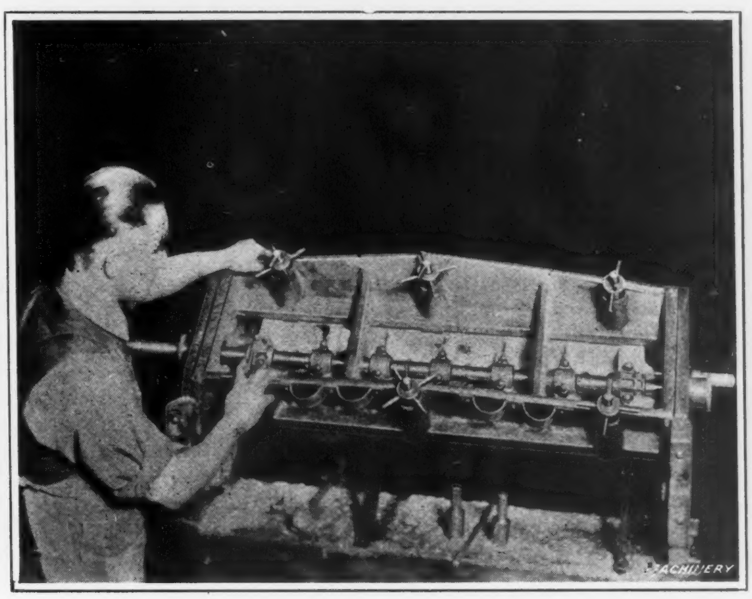


Fig. 13. Special Boring Machine used for finishing Main-line Bearings in Engine Base

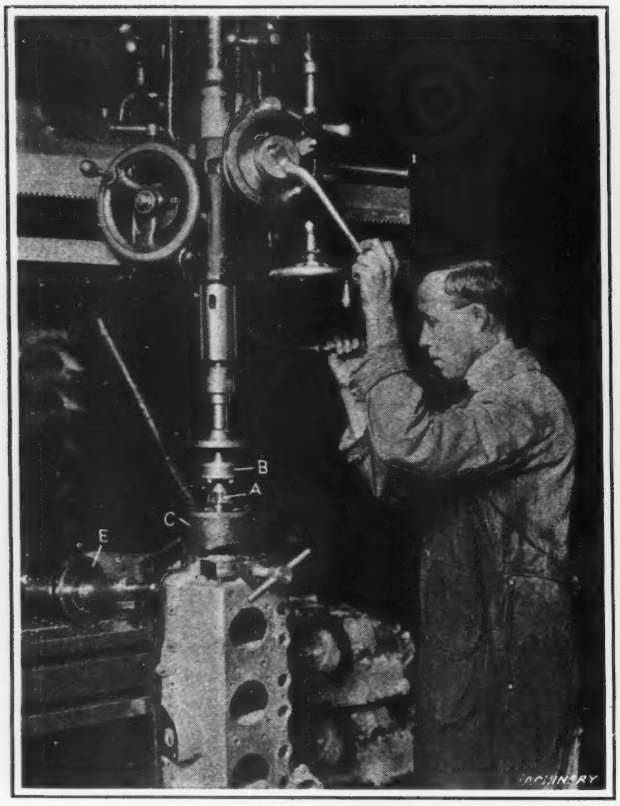


Fig. 14. Special Tapping Attachment for cutting Thread in Semicircular Seat

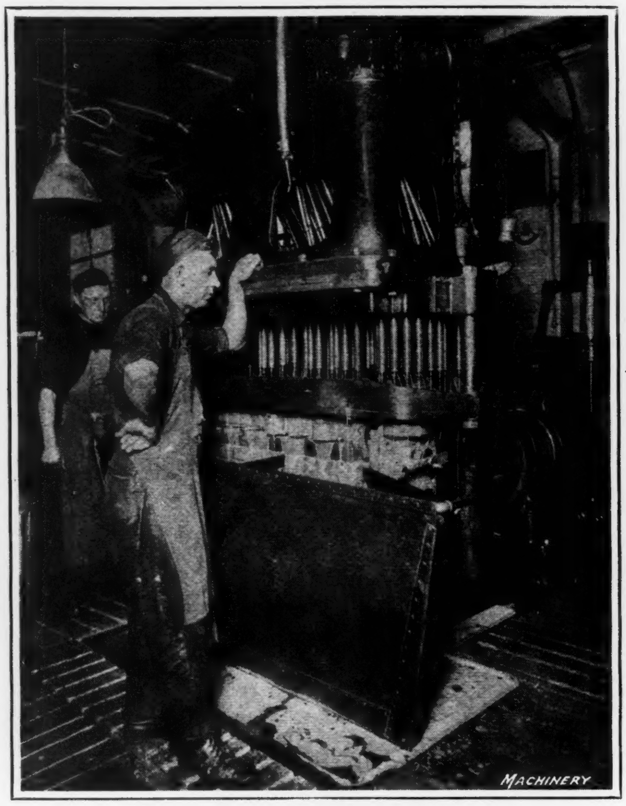


Fig. 15. Multiple-spindle Machine used for Drilling Operation on Engine Bases

The joint between the two parts divides this thread, one half being in the base and the other half in the tank casting. The thread must be cut in each casting before the two are assembled, and each half section must match to form a continuous thread, the same as though the tap were run through the hole formed when the parts are assembled. The fixture used for this operation is shown in Fig. 14. The casting is held in a vertical position against the fixture, and the thread in the semicircular section is cut by tap *A*, which has on its shank a short lead-screw *B*. As the tap is fed downward it is steadied by a pilot, and before it begins to cut the thread the lead-screw enters a nut in part *C* of the fixture. The tap and lead-screw always remain in the same relative positions, and as the work is also located the same in each case, the half thread is cut the same in each casting and it matches with the other half thread, because the latter is also cut by means of this fixture. Just below this threaded part of the casting there is a semicircular recess formed by the tool seen on the table at the left of the fixture. The cutter of this tool is pivoted approximately in the center and the upper end is tapering, so that when collar *E* slides upward on the shank of the tool, the lower end of the cutter swings outward. In use, the pilot enters the hole in the fixture and then collar *E* engages the top surface of part *C*, thus gradually forcing the tool outward and forming the recess to the required depth.

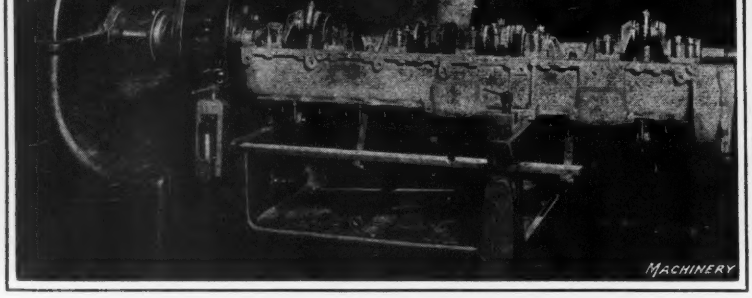


Fig. 16. Power-driven Stand for testing Crankcase Bearings

The construction of a modern automobile motor requires the drilling of a large number of holes, and this work must be done very rapidly in order to avoid an excessive overhead in the drilling department. One of the large multiple-spindle drilling machines used in the Franklin plant is shown in Fig. 15. This view shows how the machine is used for drilling engine bases on the bottom side, and at the same time for drilling the holes required in the end of the base, two castings being drilled simultaneously. One casting is clamped in a horizontal position, and the other is held in a vertical position against the end of the fixture. Seventy holes are drilled at one time in the bottom face and end. After one lot of castings has been drilled in this way, sixty-three spindles in other positions are provided with drills, and the same machine is used for drilling the top side of the base castings.

The machine and fixture used for tapping the engine base holes are illustrated in Fig. 11. The machine is a post-radial type, the frame being pivoted at the post or supporting end and also in the center. This machine has an aluminum alloy frame to reduce the weight and make it easier to manipulate. An Errington tapping attachment and a "Magic" chuck are used. The fixture is of the trunnion type and has an indexing disk and plunger for locating it in different positions. This simple equipment has proved very satisfactory and rapid. Thirty-four holes of different sizes are

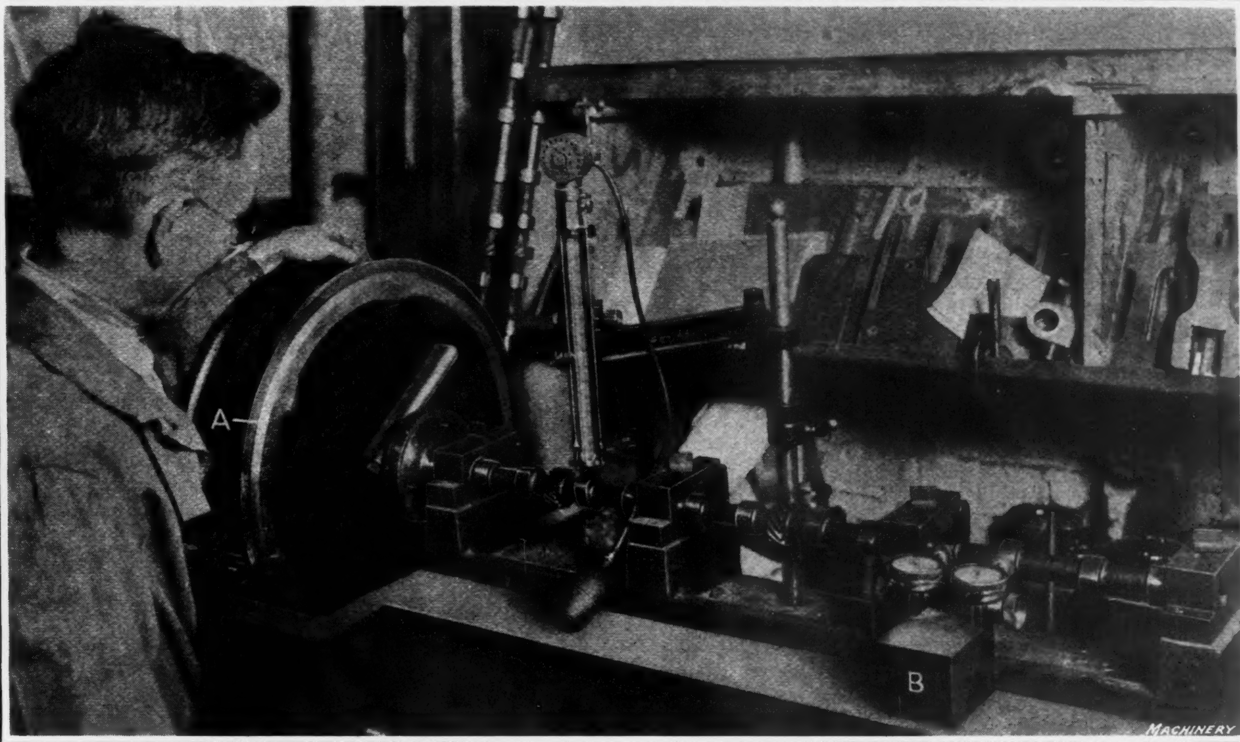


Fig. 17. Fixture for testing Accuracy of Camshafts

tapped on one side of the casting, and twenty-nine on another side in fifteen minutes.

Power-driven Fixture for Testing Main Crankshaft Bearings

Notwithstanding the great care with which the main bearings of the crankcase are bored, it is desirable to scrape them lightly at different points to relieve any high spots which may exist and secure an evenly distributed bearing surface and a perfectly free movement without play. In order to locate any bearing spots that require relieving slightly, the crankshaft is rotated slowly in the crankcase bearings. Formerly this was done by hand, but now there is a battery of six machines in the engine assembling department for revolving the crankshafts by power. One of these machines is illustrated in Fig. 16. This machine, which is controlled by a hand-lever, revolves the crankshaft long enough to reveal any high spots in the bearings; then the crankshaft is removed and the crankcase bearings are examined and scraped wherever necessary.

Camshaft Testing Fixture

The camshafts are tested to check the shape and angular positions of the suction and exhaust valve cams by means of the fixture shown in Fig. 17. This view also shows the scleroscope employed for testing the hardness of the cam surfaces. The large dial at *A* has marks on the edge representing the opening and closing points of the suction and exhaust valves. When a camshaft to be tested is placed in the fixture, the mark representing suction valve No. 1 is set opposite the fixed zero mark; then the camshaft is turned until the dial gage on block *B* (which has previously been set to zero when in contact with the dwell of the cam) moves to the 0.015 inch graduation, which is the clearance allowance. The camshaft is then locked to the large graduated disk and the six pairs of suction and exhaust valves are tested, there being graduations on disk *A* for each cam. A limit of 8 degrees at the outer edge of disk *A* is allowed at the opening and closing points, which means a very slight allowance on the cam itself, since the disk is as large as the flywheel.

Valve Grinder

The special machine used for grinding-in cylinder valves has eight stations or working positions which are similar to that shown in Fig. 18. This machine is designed to revolve the valve rapidly, reverse its motion at frequent intervals, and change its position relative to the seat, so that

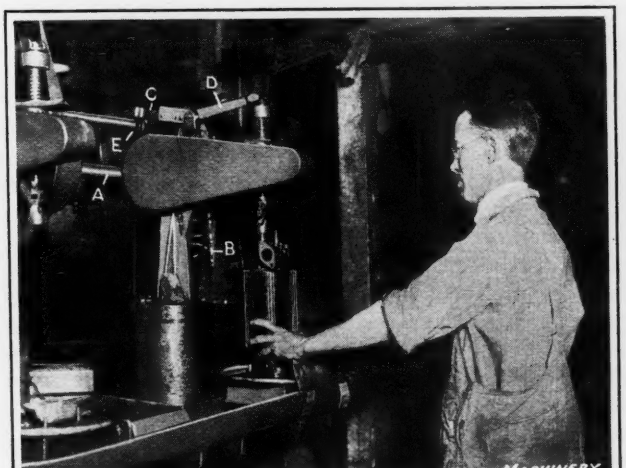


Fig. 18. One Head of the Multiple Valve Grinding Machine

Fig. 19. Rubbing a Franklin Hood with a Brown Rubbing Machine

the latter will be ground uniformly. The main shaft *A* drives a crank through spur gearing, when the crank is engaged by a clutch controlled by hand-lever *B*. This crank imparts a reciprocating movement to a rack which meshes with a pinion on the valve-grinding spindle, so that the latter revolves first in one direction and then in the other. Between the upper and lower sections of the spindle there is a universal joint which allows the valve to align itself and rest evenly on the seat. When the crank mechanism is engaged by shifting hand-lever *B*, the sections *C* and *D* of a cam-lever are also locked, so that cam *E*, at every revolution, exerts pressure on the grinding spindle through the spring shown. Ground flint is used as a grinding abrasive, and about 1½ minutes time is required to grind the seat. Immediately after the grinding operation each cylinder is tested under air pressure to make sure that the grinding has been done properly.

Power-driven Machines for Rubbing Painted Surfaces

The fine finish on the car bodies, door panels, hoods, etc., of the Franklin cars is obtained by rubbing down the different coats of paint until perfectly smooth surfaces are secured. This work, when done by hand, is slow and laborious, and this fact led to the design of the Brown rubbing machine. Fig. 19 shows one of these machines rubbing down the painted surface of a hood. The machine has two rubbers which are given a reciprocating motion. These rubbers move in opposite directions, and are driven by compressed air which enters cylinders containing aluminum pistons connecting with the rubbers. The machine is controlled by a small latch operated by the thumb of the right hand. The water used flows down to the surface being rubbed, through a small pipe connecting with an overhead reservoir. The machine weighs twenty pounds and is supported by the two rubbers and a flat base; the operator simply has to guide it over the surface. The rubbing members are so arranged that it is possible to rub an uneven or a rounded surface, and the machine can be used on vertical as well as horizontal surfaces. The first rubbing operation on the aluminum bodies is on a metal surface, and an abrasive is used. When rubbing color varnish coats, felt is employed. This machine has made it possible to rub about twice as much work as was formerly done by hand.

* * *

DYNAMIC BALANCING STAND

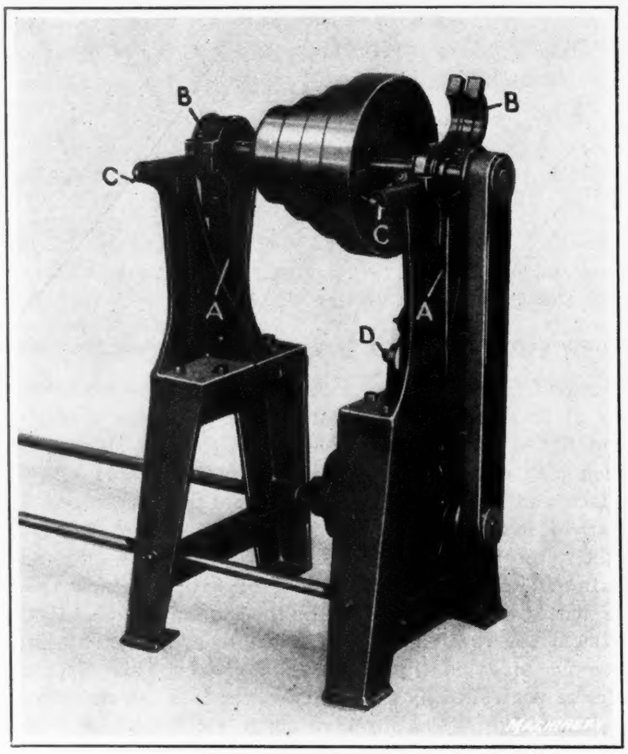
In an article "Dynamic and Static Balancing," published in the December, 1918, number of MACHINERY, an explanation was given of the requirements that must be fulfilled in order to bring a rotating member into dynamic and static balance. Equipment used by various manufacturers for the purpose of obtaining dynamic balance was also described in this article and in the subsequent article on this subject which appeared in the January, 1919, number.

In the accompanying illustration is shown a balancing stand developed by William S. Gould, works manager of Fay & Scott, Dexter, Me., and used by that company in obtaining a condition of running or dynamic balance in cone pulleys and other rotating machine parts. While this machine differs little in principle from the machines already described in MACHINERY, the structural details are somewhat different.

It will be seen that the two bearing housings are supported by flat springs *A*. These springs are 2¼ inches wide by 3/16 inch thick. The bearing housing caps *B* are hinged in order to facilitate the insertion and removal of the arbors on which the work is held. The housings are equipped with light-weight self-aligning S K F ball bearings, which are fitted to the balancing arbor by means of adapters. By the use of adapters of different sizes, any balancing arbor up to 1 15/16 inches in diameter can be employed.

The bearings are backed up on each side by cushions consisting of a plunger actuated by a coil spring, the tension of which may be adjusted by screws *C*. It will be noted that provision has been made for extending the stand to take work of various lengths. To change the distance between the stands, it is only necessary to loosen two set-screws and slide the left-hand stand along the two 1-inch rods which tie the stands together. The arbor that supports the work is driven by a ¼-horsepower motor, running at 1200 revolutions per minute, which is mounted in the lower frame of the right-hand stand. The motor starting switch is located at *D*. The balancing arbor is driven by a belt which runs on a pulley attached to the end of the arbor.

The procedure in balancing a cone pulley, for instance, is as follows: After the cone pulley has been finished all over, it is mounted on a balancing arbor. Adapters of the proper size are then placed at each end of the arbor, the S K F ball bearings being mounted on the adapters. After attaching the pulley at the end of the arbor, this completely assembled unit is placed in the balancing stand. The ball bearings are then clamped securely in place by means of



Dynamic Balancing Stand for obtaining Balance of Cone Pulleys and Similar Parts

caps *B*. After coating the exposed surfaces of the balancing arbor at each end of the cone pulley with Prussian blue, the driving belt is attached and the motor started. If the pulley is out of dynamic balance, the vibration resulting from this condition will be transmitted to the bearing housings. The housings being supported by flat springs *A*, are, in turn, vibrated, the magnitude of the vibrations being somewhat limited by the cushion springs at each side of the bearing housings. When the motor has attained the required speed, two fine-pointed scribers are advanced at each side of the pulley until they reach a point that leaves a slight mark in the Prussian blue. The direction of rotation is then reversed and the scribers again advanced, after being moved a sufficient distance along the arbor to prevent the second set of scribed marks from coinciding with the first set. These marks enable the operator to determine the light and heavy portions of the pulley so that he can either attach weights to the light side or remove material from the heavy side. The amount of weight to be added or the material to be removed must, of course, be determined by experiment. After adding weights or removing material, as the case may be, the pulley is again placed in the balancing machine, this operation being repeated until there is no vibration of the pulley.

Progressive Assembly Conveyors

Advantages of System in which Products being Assembled are Conveyed Past the Assembler

By C. W. STARKER

THE fundamental idea of facilitating the transporting of material over relatively short distances by some form of conveyor dates back to early periods of engineering development. The use of conveyors for such hauling purposes broadened as labor costs rose and the quantities of material to be handled increased with the large-scale operation of modern plants. Accordingly, many different types of conveyors have been brought out, among which are power-driven conveyors using flat belts for carrying the material; power-driven chain-operated conveyors with buckets and various other suitable containers or supports; and gravity conveyors in which the material travels over freely revolving and closely spaced rollers, this type being used when it is possible to have the material travel down a slight incline.

Conveyors of these classes are applicable to a wide field. In connection with the generation of electrical energy in large central stations, conveyors are employed for hauling coal and ashes; building construction would be almost impossible without mechanical conveyors for handling gravel, and cement; and, finally, in large mail order houses or canning plants, etc., the handling of the thousands of barrels, boxes, and packages of all descriptions would be a tremendous problem if it were not for the so-called merchandise-distributing conveyors used.

Advantages of Material-hauling Conveyors

In most cases, the advantages gained by employing conveyors exceed what might be expected offhand. It is not merely a matter of substituting mechanical means for the physical efforts of men, with the corresponding saving in handling cost, but there are many other gains, depending to a certain extent on individual conditions. For instance, the systematic and continuous receiving and delivering of material is conducive to rapid and orderly production, and invariably results in a great saving of valuable floor space. Anyone who has had occasion to observe a crew of men handling material, as for example, unloading bundles from a freight car, by the hand method, in which each bundle is passed from man to man, and then has seen a crew handling the same material on a conveyor, will have noted the greater stimulus afforded toward speedier work and will have observed how much less monotonous and tedious the job becomes.

Conveyors on which Operations are Performed

From material-hauling and merchandise-distributing conveyors, the success of which has been demonstrated so long and in many industries, it would seem but a short and logical step to the application of the same principles for hauling parts during a manufacturing operation, or between one manufacturing step and the next one. However, it remained for the automobile industry with its progressive spirit to really make a start in this direction. In connection with the japanning of products, overhead conveyors have been developed. The parts on which the japan coating is to be baked, such as automobile fenders, etc., are supported on rods 5 or 6 feet long and spaced about 6 inches apart which are propelled by a chain at the desired speed. These are arranged as either intermittent or continuous conveyors.

In the former type, the parts to be enamelled are hung on a section of the conveyor equal to the length of the oven. When the conveyor is started, the work passes into the oven, while that which has been there passes out at the far end, where it is allowed to cool prior to receiving the next coat. The oven is closed during the time of baking, which varies from one to two hours, the baking temperatures ranging from 400 to 500 degrees F. The conveyor is in motion only during the loading stage, and as it travels about 20 feet per minute and the length of such ovens is about 20 feet, the time of loading is approximately one minute. By this method, therefore, the heat loss is minimum and the time required for loading and unloading is a fixed and readily controlled amount, so that steady and full production is assured.

The continuous type of japanning conveyor is in motion constantly at a rate of approximately 2 feet per minute, and so a correspondingly greater oven length is required than on the intermittent conveyor. The oven length depends upon the baking time required. The ovens, in this case, are usually installed overhead in order to conserve the heat.

Second and third japanning operations can be readily taken care of by adding other units as required, either in a straight line, or, if the available length of floor space is limited, by placing the ovens side by side and alternating the direction of conveyor movement.

Progressive Assembly Conveyors

The application of the same conveyor methods to assembling operations is obviously so advantageous that now, after they have been in use for some years, it is a wonder that they were not developed long before. Credit for first operating a progressive assembly conveyor is generally conceded to belong to the engineers of the Ford Motor Co. They were the first to realize that labor costs are less and assembly time is reduced when the unit being assembled is conveyed past supplies of component parts, than when the component parts are transported to a stationary assembling location. The first unit on which this method was tried by the Ford Motor Co. was not in the assembly of the chassis or in the final assembly of the car, as might have been expected, but rather in the assembling of magnetos. Skilled men were required on this job when it was done by the bench method, each man performing the entire assembling operation from beginning to end, and the resulting product, depending as it did on individual skill, was far from uniform.

With the progressive assembly method, however, a job is split up into many simple steps, each one of which may be performed by an operator generally termed unskilled, but who soon becomes an expert on the one step he performs. This being the case, it is possible to pay such a workman higher wages than he would be able to earn on a job requiring more all-around skill, and the consequence is that he is loath to leave the more profitable employment. In the case of the Ford magneto, the assembling operation was split up into twenty-nine different steps by which the original assembly time of 20 minutes per man by the bench method, was reduced first to 13, then to 7 and later to 5 minutes.

The proper conveyor speed is a matter that can only be determined by actual operation and can readily be adjusted as the perfecting of the process goes on. In the case cited, a travel of 5 feet per minute was soon found to be much too fast, and when reduced to 1 foot 6 inches per minute was found too slow. By trial the best speed was determined to be 3 feet 8 inches per minute. The assembling of automobile engines, when done at the bench, required 1100 men working nine hours per 1000 motors. A year later, by the use of a progressive assembly conveyor, the same amount of work was accomplished by 472 men working eight hours. Expressed in the number of minutes each man spent in the assembly of one motor, for easier comparison, the bench time was 594 minutes against 226 minutes conveyor time.

Advantages of Progressive Assembly Conveyors

Today progressive assembly conveyor methods are used by all large automobile manufacturers. The principal advantages of the system may be summed up as follows:

Use of unskilled help, highly trained and most proficient in the performance of individual tasks, as against the expert all-around workmen required in assembling a complete job at a bench.

A job carefully studied in every detail and segregated into operations of short periods of time, as against an assembly job left completely to each man with a consequent lack of control in the rate of output and a lack of uniformity in the parts assembled.

A continuous rate of production and a definite output. The operator does not lose time hunting up material, but has the job right before him. The lagging operators are helped by instructors to keep the established pace.

The necessity of the entire organization functioning with accuracy and reliability from the purchasing to the assembling and shipping departments. All departments must do their full share in order to maintain a continuous flow of supply parts to the assembling conveyor.

Ability to pay higher wages to operators than otherwise, as they work to better advantage on the segregated steps. They learn their individual tasks quickly, and as previously mentioned, are not inclined to leave a job when they earn more than they could on less detailed operations. The result is a low labor turnover—a factor which, in the past, has been a great and often under-rated source of expense.

Effect of System on Quality of Product

The full benefits of progressive assembly conveyors can only be secured when every component part delivered to the conveyor is made to the degree of perfection necessary for it to be assembled with the other parts, without losing time in excessive fitting. This has the beneficial effect of compelling each feeder section and each inspector in these sections, to maintain a high quality of the component parts, which results in a high quality of the assembled product.

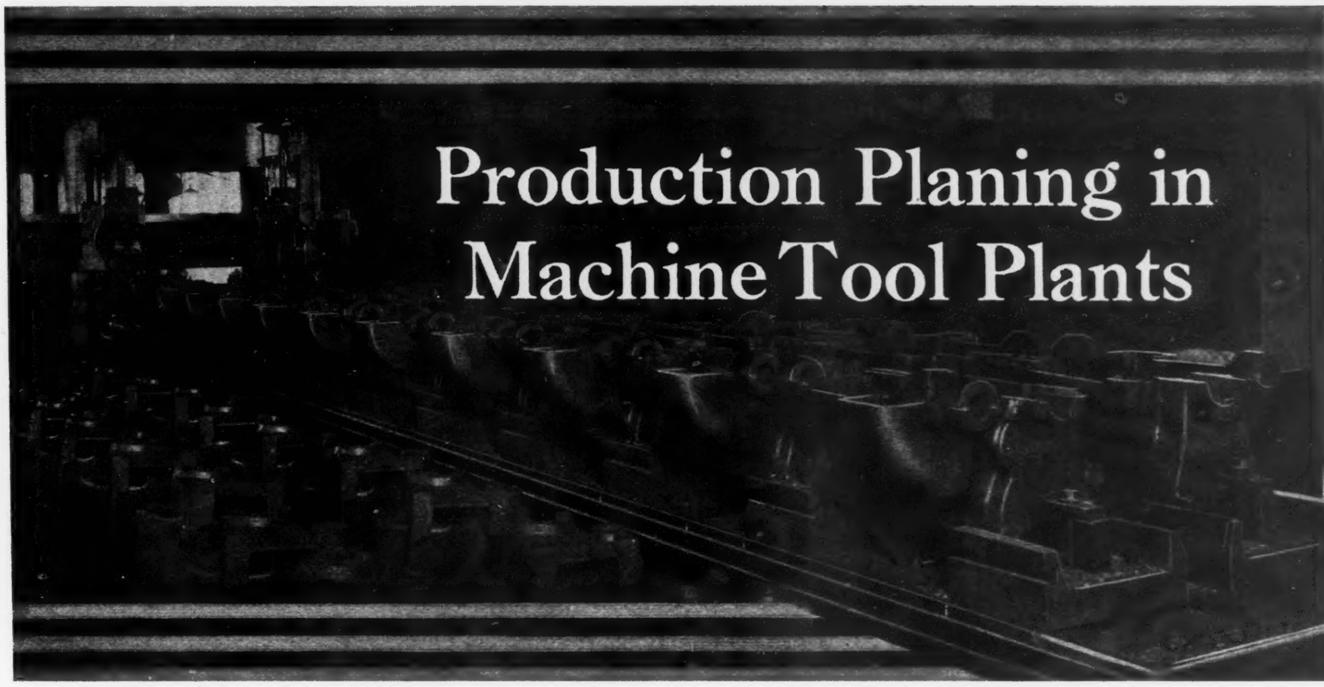
In the same way, it may be said that a fairly standardized product, manufactured regularly in large quantities, is necessary in order to derive the full benefits from the progressive assembly conveyor plan. Special modifications of the product must not necessarily be eliminated, but it is only just that the greater cost entailed in their manufacture be charged to them. If, however, at any time the demand for some of these modified products becomes large enough, there is no objection to running the conveyor, at least part of the time, for these now standard articles.

Products need not be made in very large quantities to make this assembly procedure a paying proposition, or rather, conveyor assembly does not necessarily presuppose an unusually large volume of work. A broad general statement as to the required quantity of products cannot be made; each individual case must be studied and a cost comparison made, considering a possible reduction in the manufacturing cost of the product, together with the other gains that have been referred to.

New Fields for Progressive Assembly Conveyors

In view of all their advantages, there is no doubt that progressive assembly conveyors will be used much more extensively than they have been in the past. One interesting step in this direction has been made by a large manufacturer of stoves and ranges, and the conveyors in this plant have been in operation long enough to furnish reliable and interesting data. The installation consists of two conveyors of the type shown in the heading illustration, on which the work rests on chain-propelled hard maple slats 28 inches long, 6 inches wide and 2 inches thick. The working surface of the conveyors is 30 inches from the floor, each conveyor is 180 feet long, and driven by a 3-horsepower motor running at the rate of 1100 revolutions per minute. The motor is provided with an enclosed spur and worm gear reduction. The conveyors travel from 1½ to 2 feet per minute, and the ranges being assembled are spaced about 6 feet from center to center. At a travel of 1½ feet per minute, therefore, 15 ranges are assembled per hour or one every 4 minutes. Twenty men in nine hours produce from 240 to 270 stoves.

In addition to being now able to use unskilled help and to hold its men, the concern, through the installation of these two conveyors, has been able to transfer 100 men from assembling to other operations. At a saving of $7 a day a man, this means an annual saving of about $200,000. A more uniform output and an improved quality of product were noted from the beginning, and the saving in floor space was 27,000 square feet. In this instance, two hours of instruction have been found sufficient to train the average workman adequately to take his place on the line. Other industries that would no doubt be benefited by progressive assembly conveyor methods are the manufacture of agricultural implements, all classes of moderate-size machinery, furniture, pianos, electrical appliances, phonographs, etc.



Production Planing in Machine Tool Plants

Efficiency Factors in Production Planing—Points to Observe in Obtaining Maximum Output from Planers

IT is the general practice to bring rough castings to the planer and make the work done on this machine the first operation; then the planed surface is frequently utilized as a locating point for subsequent operations. However, there is no definite reason for this procedure, and some shops make a practice of performing various milling, boring, and other operations on their work, after which it is brought to the planer that does the roughing and finishing operations on the surfaces that are finished on a machine of this type.

Methods of Setting up Planer Work

Owing to the great diversity of sizes of work to be planed, it is natural that many different methods are used in setting up planer jobs. Such methods must be adapted to both the size of the castings or forgings to be planed and the condition of the work when it comes to the planer, as well as the nature of the operation to be performed. In planing various small pieces of work, it is feasible to provide work-holding fixtures of suitable form, and typical examples of such fixtures have been illustrated and described in previous installments of this series of articles; but for handling large heavy castings, it is quite the general practice to set the work on a number of small blocks placed directly on the planer table, and the setting up of such work calls for far more judgment on the part of the planer-hand than is the case where work-holding fixtures are provided. This is quite naturally the case because not only are large pieces heavier and more difficult to handle, but as there is no fixture to assist the operator, it is chiefly his judgment that determines the accuracy of the finished work.

Importance of Solid Foundations

In setting up large heavy pieces of work, the points of primary importance are to provide a solid foundation; to have the work properly leveled up; and to arrange for finishing the planed surfaces in correct relation to the outside faces of the casting, and to the various bearing bosses and other fixed points. Obviously, it is important to have a solid foundation for the work, because if there is any tendency for a casting to move while being planed, accurate results cannot be secured. There is another important consideration, namely, the fact that all materials are flexible in amounts that vary according to their form, and this point is also of importance in connection with the leveling up of the work.

All men of experience in handling engineering materials know that even the heaviest castings, and other metal parts of considerable length, will sag to an appreciable extent if the method of support is such that there is a large amount of overhang from the point or points of support. Take the case of a large casting held on a planer table by blocks which raise the work sufficiently so that, if necessary, it is possible to plane the sides down to the bottom without damaging the planer table. Not only is it important for the height of the different blocks under the work to be so adjusted that each block comes into contact with the under side and carries its proper proportion of the load, but flexure of the casting must be taken into consideration, and the blocks must be located and adjusted in such a way that the work will be held in its normal position.

Application of Principle that Three Points Determine a Plane

In setting up planer work, as in the design of work-holding fixtures for use on various other types of machine tools, use is frequently made of the geometrical principle that three points determine a plane. To explain the value of this principle in the present instance, the old analogy is drawn between the facts that a three-legged stool will always stand firmly on the floor regardless of its inequalities, while a four-legged stool will almost invariably be found to rock back and forth, because one of its legs does not find a firm foundation. In setting up a large piece of work that is

Maximum output in the operation of any type of machine tool can only be obtained through a careful study of all conditions which affect production. In the setting up and planing of production work, there are many apparently trivial points which constitute what may be designated as "efficiency factors," because they determine the rates of output, and the consequent labor and overhead costs that must be charged against every piece turned out.

to be planed, many shops make a practice of first placing three blocks between the work and the planer table, which are used as a preliminary foundation for supporting the work.

Determining Locations of Three Supporting Points

The Niles Tool Works Co., of Hamilton, Ohio, builds a great many heavy-duty machine tools in which there are parts made from large castings, and this company's methods of setting up these heavy pieces for planing are based upon knowledge gained through years of experience. In these shops, the three blocks on which the work is supported are located according to the following rule, the arrangement of blocks *A* being shown diagrammatically in Fig. 1. Two blocks are placed at one end and one block at the opposite end, these blocks being located a number of inches from each end of the work which is determined by multiplying the total length of the work expressed in feet by 2.5; thus, for a casting 34 feet long, the blocks will be located at a distance from each end of the casting which is:

$$2.5 \times 34 = 85 \text{ inches} = 7 \text{ feet } 1 \text{ inch}$$

Of course, this location for the three blocks upon which the work is first placed need only be approximate. The positions of the blocks are adjusted to take advantage of the shape of the work; for instance, if the work is ribbed, the blocks should be located beneath the ribs. The idea is to have them positioned in such a way that an approximately uniform amount of flexure will take place in the unsupported ends of the work and in that portion which bridges the distance between the blocks. After the three blocks have been placed under the casting, the method of procedure is to carefully level it up by placing paper packings or thin sheet metal shims between the blocks and the work, and also to bring the work into accurate alignment with the line of travel of the planer table. The method of procedure in accomplishing this leveling and lining up will vary according to the work, but it is important to note that in any case all adjustments of the position of the work on the planer table must be made relative to the bosses which will subsequently be machined to receive journal bearings, the positions at which slides etc., will be planed, and other similar fixed points.

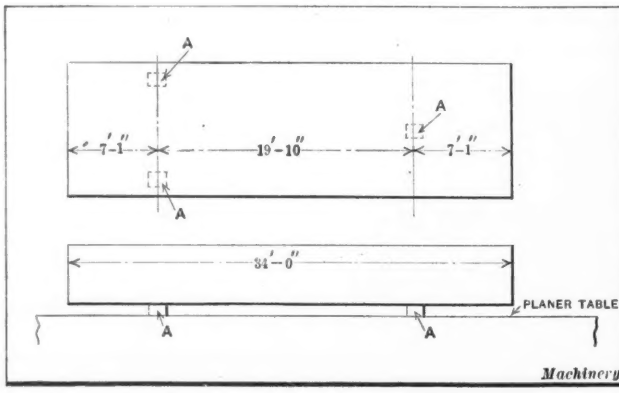


Fig. 1. Diagram illustrating Application of Rule for locating Three Primary Supporting Blocks under the Work

Laying out Work Preparatory to Planing

Reliance cannot be placed upon the outside surfaces of castings or large forgings, as these are subject to a sufficient amount of variation to frequently make it impossible to "clean up" all finished surfaces in a satisfactory manner, if the outsides of the castings were used as reference points in setting up the work. In starting to line up a piece for planing, the first step according to the method followed by the Niles planer-hands in Hamilton, Ohio, is to lay out on each end of the work the outline of the surfaces which have to be finished. This is done by taking white chalk or crayon and marking heavily around the outline of the various holes and flat surfaces on the casting which have to be machined, an example of some work laid out ready for planing being shown in Fig. 2. Then, using straightedges, squares, compasses, etc., the outline of these finished surfaces is carefully scribed on the work.

With such an outline for his guidance, it is then an easy matter for the planer-hand to level up the casting on the table of his machine and to make other necessary adjustments, so that he is sure that the various surfaces to be planed will not only "clean up" satisfactorily, but that they will also be properly located relative to other fixed points.

In most cases, such as that of the casting shown in Fig. 2, double lines are scribed on the upper and lower sides of the work, so that when the roughing cut is taken the inner line can be used as a "safety line." For the first roughing cut,

Fig. 2. Example of Work laid out preparatory to planing, to assure having All Finished Surfaces satisfactorily "cleaned up"

the tool is set to the outer line, and this leaves sufficient stock for the finishing cut. The inner or "safety" line remains on the work after the finishing cut is taken.

At the Niles Tool Works Co.'s plant all planer-hands operating machines with a capacity of 60 inches or upward between the housings are required to lay out their own work. Such is the procedure at present; but it is planned to install surface plates and have specialists who do nothing but lay out work, as it is believed that their intensive training in this important branch of machine shop practice would enable them to not only do better work, but also to effect a saving of time.

Supplementing the Three Primary Supporting Points

It has been explained that three blocks are used to hold the work while obtaining a preliminary setting, but before the actual work of planing is started, these points will be supplemented by numerous blocks placed to support the work at intermediate points. However, in putting these auxiliary packings in place, great care must be taken to bring each block to such a height that it will bear its due proportion of the load but will not extend high enough to prevent other blocks from performing their proper service. The placing of these supporting blocks in position and raising them to the correct heights is part of the work that calls for considerable judgment. In building up the height of the three primary supporting points on which the work is first placed, and in putting auxiliary supporting points in position, use will be made of either a pinch bar or a screw jack, according to the size of the work. The use of such tools has been explained in previous installments of this article, so that further description is unnecessary.

For packing beneath the supporting blocks used to hold moderate sized work, the best material to use is strips of tissue paper with sheared edges. It is important to note that the practice of tearing these papers is undesirable, because it leaves a fuzzy edge; and this shredded paper along the margins may be particularly objectionable in cases where the papers are used in conjunction with gages to check the accuracy of the work. The use of sheet metal shims between the supporting blocks and work is also discouraged among authorities on precision planing, because such strips of metal are likely to be concave or convex in form, thus creating a springy foundation instead of one that is perfectly rigid. Also, there is likely to be a considerable variation in the thickness of sheet metal shims, while those made of good tissue paper are practically uniform. However, in setting up large rough pieces of work, the use of sheet metal shims is advisable. The weight of the work takes up all spring in the shims; and they are not likely to be crushed, as is the case with paper packings.

Effect of Structural Readjustments on Accuracy of Planed Work

In order to be sure of obtaining accurate results in planing, it is necessary for the man who plans the order in which various operations are to be performed to possess a knowledge of the structural readjustments which are likely to occur in a piece of metal as subsequent machining operations are performed on it. The two most important examples of this kind are the following: Where a casting first comes to the machine shop and it is required to take a cut over only one of its surfaces, the removal of the outer scale will cause the strains imposed upon the metal to be relieved in such a way that the entire casting is likely to be sprung to a considerable extent. It takes time to accomplish this change of form and, as a result, if the finish-planing operation were to be performed directly after taking the roughing cut, the casting would tend to continue changing its form after the finishing operation had been completed, and thus the accuracy of the work would be seriously impaired.

Benefits Secured by Allowing Work to "Season" between Rough- and Finish-planing

Difficulty of this kind is readily overcome by setting the casting aside to allow it to "season" between the time that the roughing cut is completed and the starting of the finishing cut. Where such a practice is followed, all of the changes of form resulting from relieving the strains imposed upon the metal by removing the outer scale will be completed during the period of three weeks that is allowed for seasoning, and then the finishing cut can be taken with assurance that the work will remain in the form to which it is planed. This practice of allowing time for "seasoning" is not necessary, in all cases; but where the work is long and somewhat thin, the effect of relieving the strains by removing the scale at one side is most pronounced, and it is on such work that the allowing of time for "seasoning" before taking the finishing cut is most imperative.

Where a piece of work has been finish-planed with a high degree of accuracy, a careful inspection with the use of accurate gages may indicate that it is perfectly true to shape and size at the time it leaves the planer; but if subsequent machine work includes such operations as the boring of holes of considerable size, the relieving of internal strains resulting from the removal of a substantial volume of metal is likely to result in a structural readjustment that will seriously impair the accuracy of the planed work. As a result, pieces that have been planed within limits that will insure their interchangeability at the time they leave the planer may require scraping after the performance of subsequent boring and other operations, in order to make them fit the parts with which they are to be assembled.

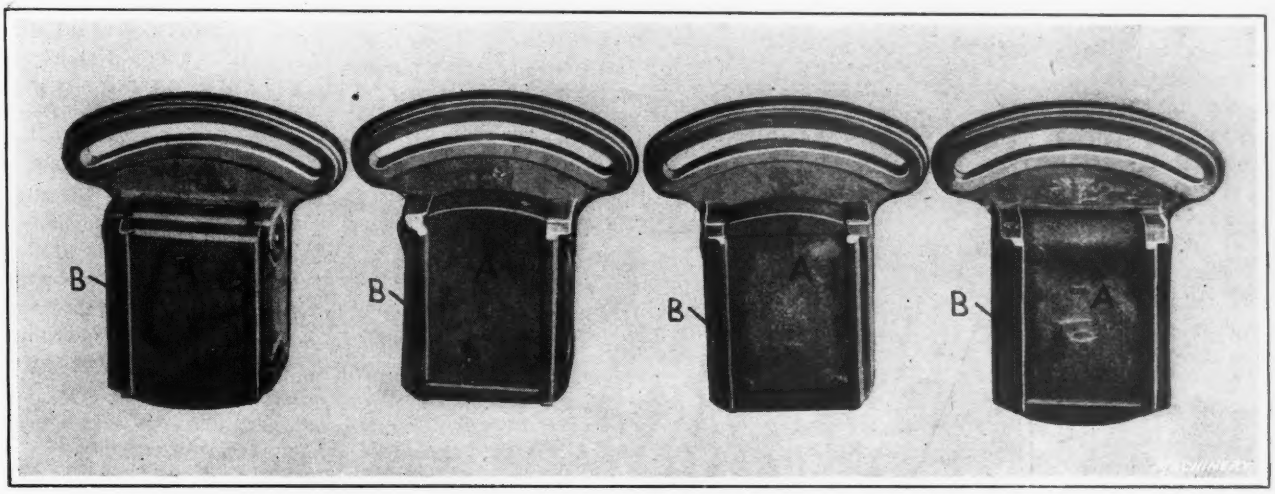


Fig. 3. Example of Accuracy Attainable in planing. Aprons A assembled in Tool-boxes B in All Possible Ways, are a Push Fit in the Boxes without requiring Planed Sides of Aprons or Boxes to be scraped

Importance of Carefully Planning the Order in which Planing Operations are Performed

Careful planning of the order in which machining operations are performed may overcome a lot of trouble of this kind. For instance, in the case which has just been cited, if the boring had been done prior to performing the finish-planing operation, the exercise of sufficient care in planing would probably have made it possible to finish-plane down to a satisfactory bearing, without the necessity of scraping, which is an operation that consumes a considerable amount of time and is therefore expensive. But frequently the nature of the work will be such that it is far more desirable to locate from a planed surface for the performance of a boring operation than to attempt to locate the piece from a finished hole for performing subsequent planing operations. As a result, many shops having such work to handle consider it more desirable to first plane the work to size, allowing a sufficient volume of metal for scraping, so that compensation may be made for errors introduced by internal readjustments of the work of the nature to which reference has just been made.

Degree of Accuracy Attainable in Planing

In many shops, the impression prevails that the planer is a machine which is only adapted for the economical performance of preliminary work on parts that have to be finished accurately, or for finishing the machine work where only a reasonable degree of accuracy is demanded. The opinion is also quite generally held that planed work requires subsequent scraping in order to bring it within close limits of accuracy. As a matter of fact, this impression is erroneous and has doubtless gained circulation through the fact that planers are widely employed for machining the vees on lathe beds and carriages, the ways on planer tables and beds, and for other work where a practice is made of subsequently scraping the planed surfaces to bring them to a bearing. However, keeping in mind the way in which scraping is done, a very little thought should make it evident that where close limits of accuracy are necessary and where the straightness of the finished surfaces is important, the result produced by performing a carefully conducted finish-planing operation should be far superior to any results that can be accomplished by the performance of scraping operations subsequent to finish-planing.

Careful consideration of this subject will make it apparent that, theoretically, the planer is ideally adapted for the production of perfectly straight flat surfaces, while scraping cannot do more than approximate the same results. It is estimated that under average conditions five strokes of a scraping tool are required to remove 0.001 inch from the surface of a piece of cast iron or soft steel, and the effect of scraping to bring two planed contacting members, such as a lathe bed and carriage, to a satisfactory running bearing, is that a series of hills and valleys is produced on the work. High points on the surfaces of two contacting members can be reduced by scraping so that a satisfactory bearing will be obtained. But surfaces reduced to the required form in this way can never be perfectly straight or flat like those obtained by finish-planing; and some authorities on this subject state that there are many classes of work where the highest accuracy is required, in which the exercise of proper care in planing will make it unnecessary to do any subsequent scraping. For instance, the G. A. Gray Co. of Cincinnati, Ohio, conducts its shop work along lines which afford some remarkable examples of results that can be attained in performing planing operations.

In building Gray planers the top brace, for instance, is planed on each end to fit a gage with such accuracy that these parts are absolutely interchangeable. The corresponding surfaces on the housings, to which the top brace is fastened, are also planed to fit precision gages. The operation of finish-planing completes these surfaces without any subsequent scraping. Similarly, the housings are planed to fit accurately on the bed, without scraping or hand fitting. The planing operations are performed with the greatest care, and by finishing the job on the planer instead of depending upon subsequent scraping to obtain the required fit, the G. A. Gray engineers claim that superior results are secured. For running bearings, such as those between the carriage and ways of a lathe, more leeway is available; but the fit between the housings and bed of a planer and between the housings and top brace must be absolutely accurate. The two contacting surfaces must not only have a good bearing, but they must be true with reference to other parts of the machine. It is possible to scrape the two surfaces to get the desired bearing, but the resultant bearing surface may be out of vertical. It is essential not only that the parts be in firm contact for the sake of rigidity, but they must also be true. It is claimed by engineers of the G. A. Gray Co. that such accuracy can only be obtained by finishing the parts on a planer. Obviously, the top brace, rail, housings, and table of a planer must be square with each other in every way, or the work done by the rail- and side-heads will not square up within the limits of tolerance required by progressive shops. Attention is called to the planing of the tongue on the planer housing and the corresponding groove in the bed. That such work can be done shows the capabilities of the planer as a precision tool.

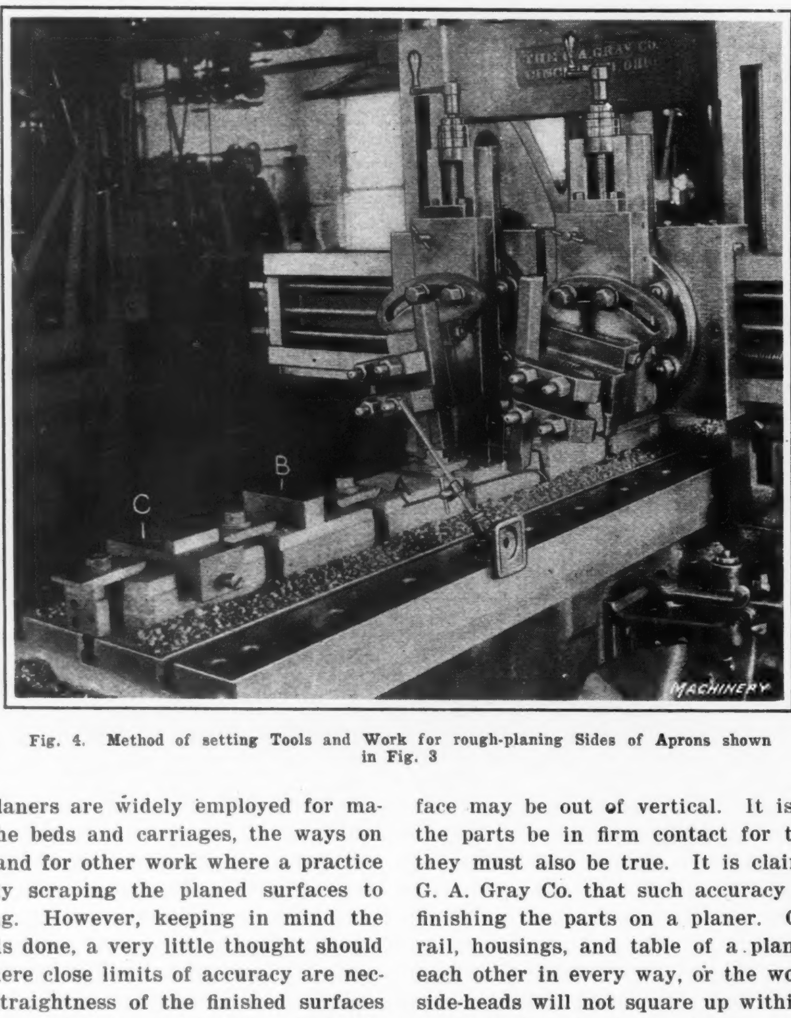


Fig. 4. Method of setting Tools and Work for rough-planing Sides of Aprons shown in Fig. 3

Fig. 3 shows in concrete form, the degree of accuracy that can be attained in the performance of planing operations, where the necessary care is exercised. In this illustration there are shown four aprons *A* and tool-boxes *B* (frequently known as clappers and clapper-boxes). These pieces were regular production parts taken from a planer in the G. A. Gray Co.'s shops, and from left to right are shown, first, an apron assembled in the tool-box in the regular way; second, an assembly in which the apron is put into the tool-box reversed end for end; third, an assembly in which the apron has been turned upside down and reversed end for end; and fourth, the apron turned upside down.

In every case, the fit between the apron and tool-box is such that the greatest care has to be exercised in putting them together to avoid turning up the slightest burr at either edge, as this would greatly retard assembling the apron in its tool-box. Also, after the apron has been started in its box, considerable pressure is required to push it into place. Certainly, the degree of accuracy obtained in the performance of the planing operations on these aprons and tool-boxes is far greater than 0.001 inch, and while it is a dangerous practice to estimate fractions of a thousandth, without having accurate means for their determination, experienced shopmen in the Gray plant express the opinion that the results obtained on this job are well within a limit of twenty-five hundred-thousandths of an inch.

Method of Procedure in Planing Aprons

Fig. 4 illustrates the performance of the rough-planing operation on the sides of a string of thirteen G. A. Gray planer aprons of the type shown assembled in tool-boxes in Fig. 3. Prior to the performance of this operation, the castings have been rough- and finish-planed on their upper and lower sides; and the finished pads on the upper side of the blocks are utilized as locating points for setting up the work for rough- and finish-planing the edges that are the points on which accuracy must be attained. In setting up the work for the performance of this operation, the first step is to line up the castings with a surface gage *A*, the base of which is furnished with a shoulder that fits over the edge of the planer table. Lying across the top of the work to be planed, there will be seen an end gage *B* that is of the same length as the width to which the tool-blocks must be planed.

Method of Setting the Rough-planing Tools

In setting the square-nosed rough-cutting tools, the method of procedure is to lay this gage *B* across the work so that it is in contact with one tool, and then to run the railhead carrying the second tool over until it engages an ordinary machinist's steel scale held in contact with the end of the gage. This scale is 1/16 inch in thickness, so that there is an allowance of 1/32 or approximately 0.031 inch for the straightening out and finishing cuts which will subsequently be taken down the sides of these castings. Having obtained the proper spacing for the tools, the next step is to provide for feeding them down to the desired depth. It is required to plane to the bottom of the castings, but care must be taken not to damage the planer table. This result is accomplished by using two thicknesses of paper, each of which is approximately 0.003 inch thick, that are laid on the planer table so the tools may be run down on these papers. When set in this position, the micrometer collar on the vertical feed-screw of each tool-head is turned to the zero position and then clamped to the screw, so that when the tool has been fed down so that its point is within 0.006 inch of the table, the micrometer collar will be at zero and the operator then stops the downward feed. Both tools are set in this manner, after which they are centered over the work, so that the sides are planed symmetrical with the center of the block. The roughing cut is then started.

Resetting Tools for Taking an Intermediate Cut

After the roughing cut has been completed, the same tools are reset on gage *B* in the manner just described, except that three sheets of tissue paper, each of which is 0.001 inch in thickness, are placed between each end of the gage and the tool which is brought in contact with it, thus allowing 0.003 inch of surplus metal at each side of the work for the final finishing cut. After this second roughing or straightening out cut has been completed, gage *C* is used for setting a pair of side finishing tools which perform the final operations. These tools are set to run down the table in the same manner as previously described, except that in the present instance tissue paper feelers are used to provide for running the tools down to within 0.002 inch of the table. The spacing between the finishing tools is set on gage *C* which is ground to indicate a distance 0.001 inch less than the length of gage *B*. As a result, the side finishing tools set against a tissue paper feeler complete the planing operation and assure bringing the work to a width exactly equal to the length of gage *B*. Dependence is placed upon the accuracy of the tool setting to bring the work to the required size, and no gages are used to test the dimensions of the finish-planed tool-blocks after the final cut.

It is blocks planed in this way which go together in any of the four possible positions to which attention was called in connection with the four assembled tool-boxes and aprons shown in Fig. 3, and for all positions the apron is a tight push fit in its box. However, it is necessary to bore holes in the apron to provide for securing the toolpost in place, and as previously mentioned, the removal of metal in this way causes an internal readjustment that is likely to result in substantial changes in the form of the finish-planed work. For that reason, the aprons and tool-boxes will often have to be scraped to a fit; but it is important to note that in the condition in which they leave the planer, these parts fit together accurately, as shown by the four different assemblies in Fig. 3.

* * *

COST OF CHANGING TO THE METRIC SYSTEM

According to information given out by the American Institute of Weights and Measures, 115 Broadway, New York City, W. M. McFarland, manager of the marine department of the Babcock & Wilcox Co., is quoted as stating: "While I was with the Westinghouse Electric & Mfg. Co., we made a careful estimate, about fifteen years ago, when the business of that company was much smaller than at present, that the direct and immediate cost of the change from the English to the metric system of measurement to that company would be between $500,000 and $750,000, without allowing for the loss due to inconvenience and reduced efficiency during the period of change."

C. D. Morse, president and general manager of the Dependable Truck & Tractor Co., is quoted as follows: "The writer had occasion to make a change in the system of measurements while connected with the American Locomotive Co. at Providence, R. I., where the 'Alco' pleasure car and truck were manufactured. . . . The company took over the Bleriot car, a French product, using the metric system, and incorporated the design in their own pleasure cars and trucks, but finally decided to change from the metric to the English system. . . . The tools, jigs, and fixtures for this alteration cost approximately $90,000."

The Cleveland Chamber of Commerce, in its report against the adoption of the metric system, gives an elaborate and detailed estimate of the cost of such a change as applied to a prominent Cleveland manufacturing concern. According to this estimate, the expenditures incurred in a change from the English to the metric system would be $380,000 in the engineering, factory office, production, sales, and general office departments. In addition there would be an estimated annual expenditure of $93,000 due to the persistence of the use of old standards and the carrying in stock of both old and new standard products.

* * *

It is reported that fifty of the largest firms in Holland have combined and founded the Netherlands-Baltic Trading Co., with the object of establishing business relations and carrying on trade with the East European countries, including Russia. Representatives of the company are leaving Holland to establish offices in Finland, Esthonia, Lithuania and Poland, and to enter into negotiations with representatives of the Russian Soviet at Berlin.

Developing a Machine Tool Market in China

By O. H. BROXTERMAN, President, John Steptoe Co., Cincinnati, Ohio

IN times of prosperity the American manufacturer of machine tools is naturally inclined to look first to the American market for business and to consider the foreign market only as a matter of secondary importance. This condition should be reversed; in times of prosperity we should give to the foreign market our first consideration, and spend such time and money as might be necessary to establish a future market for machine tools when trade depressions in America prevent us from getting enough domestic business to run our plants. It is quite natural for us to look to foreign markets in periods of depression in America, but if we have neglected our foreign opportunities during times of prosperity, we cannot hope to build up in a few days a market that will enable us to keep our plants running in periods of depression.

Under present conditions the European market affords little opportunity for machine tool manufacturers. Most European countries are experiencing the same depression that we are, with the additional disadvantage of an unfavorable rate of exchange.

Russia at some time in the future will probably be a favorable market for machine tools, but Germany has always had the advantage in this market, and at present, with the low value of the mark and the unsettled conditions in Russia, we can hope for little from that market. Japan is proving very aggressive in Russia, and if the newspaper reports are true, with Japanese soldiers controlling a large section of Russian territory, they are undoubtedly going to receive a portion of the trade when the opportunity presents itself. There does not, however, appear to be any possibility of business in Russia for some years to come.

French Efforts to Obtain Chinese Trade

There is, however, one market which looms up very favorably and where Americans will always receive consideration. I refer to China. China with her four hundred million of population is beginning to realize the advantages of modern methods and efficiency. This is probably due, in a great measure, to the thousands of Chinese who worked behind the armies in France during the great war, and a plan of cooperation that has been agreed upon between the Chinese and French Government, by which France is to receive from ten to twelve thousand Chinese students for a one year's training in European civilization. These Chinese students return to their country at the end of one year and spread the gospel of French civilization, French methods and efficiency. The French steamship companies offer an exceptionally low rate to these Chinese students, and it is said that the students come from the better classes of Chinese families.

Japan for a long time received by far the greater portion of Chinese students into her colleges and universities, and had a very strong hold on the Chinese trade. However, since the great war, Japan has lost her advantage by her acts of aggression, and a severe boycott was instituted against everything Japanese; as a consequence, students instead of going to Japan for training are going to France and America. France was undoubtedly actuated by a desire, immediately after the war, to get labor into her mines and mills, thereby increasing their production. After spending one year in the French factories, the Chinese students would naturally go back to their country enthusiastic about French products.

Chinese Students in America Should be Taught Engineering

Chinese students have been coming to America as a result of the Boxer indemnity fund, but we have been teaching the Chinese students to become doctors of medicine, philosophy, or law, while in France, Chinese students are being trained in the handling of machine tools and educated by doing things by French methods. While we are turning out doctors and lawyers, France is producing mechanics to go back to China and herald the advantages of French machinery. It is only natural that being taught engineering in French and English schools, they will go back to China and demand European tools and other machinery which they have been accustomed to handling. American manufacturers must begin to act, since the foreign manufacturers, by the aid of their governments, are making every effort to gain a foothold and establish a firm foundation for their business.

The movement on the part of the French manufacturer and the French Government, however, has not worked out altogether advantageously. Students by the thousands have flocked to France, and I understand that at the present time they are having a very hard time to make a living and support themselves, due to the stagnation of business in France. They are also unable to return to their own country, because of lack of funds, and I believe that this movement will eventually prove a boomerang, as the Chinese Government has stopped the students from going to France.

Efforts Made to Train Chinese Engineering Students in America

The feeling toward America, on the part of China, is very favorable, but we have been seriously handicapped due to the Chinese Exclusion Act and a decision by the Department of Labor preventing students from coming to America and working in shops as a part of their practical training. These difficulties, however, have been overcome by hard work on the part of Elmer Yelton, secretary of the Committee on Friendly Relations among Foreign Students, of the Y. M. C. A., in New York. The Department of Labor has recently ruled that Chinese students can come to this country, and they can also work in machine shops or other establishments, as long as they do not work for wages.

This has opened for America and the machine tool builders especially, an opportunity for securing Chinese students of high quality for practical education in the handling of American machine tools, and if the American manufacturer will cooperate by taking in these prospective Chinese students, we can return to China a number of these boys every year as missionaries of the advantages of American machine tools. If we can send these boys back full of enthusiasm for the American products, there will be little opportunity for other makes of machine tools.

Methods Used by Other Nations in Developing Trade

The English have established the Anglo-Chinese College at Foochow, which naturally teaches the advantages of English products. In addition to this, there are a number of English papers published in China which are continually showing the advantages of English-made goods. On the other hand, there are also some influences at work that in a measure assist us. The Y. M. C. A. has a very large organization in China, which through its charitable and religious work is a very influential factor. This has created a feeling of good will for America. The Peking University,

which is being conducted by the United Religious Bodies, is willing and even anxious to establish a machine shop in connection with the school and to assist in the selection of students in China for American schools and industries.

America has by far the greatest advantage in China, if we will make some effort to retain this advantage. Germany, before the war, secured her hold in South America by either selling very cheaply or donating to all the schools throughout South America such equipment as power plant, machine tools, agricultural machinery, etc., and we must do something similar in China, or bring the Chinese students to America and teach them the advantages of American machine tools. We should make a special effort to see that American machine tools are placed in every school machine shop in China. The thousands of students that go through these schools and operate our machines, having learned the advantages of American machine tools, will certainly give us the preference when they become purchasers.

It is estimated by reliable authorities that we have approximately 1500 Chinese students in the academic courses in the United States today. Approximately 150 to 200 of these students would be glad to take up mechanical engineering. All of these students have high school or college education, and could be placed in our shops under a co-operative plan of education, in which the student would spend part of the time in school and part of the time in the shop. Arrangements could be made for the selection of the highest grade of students in China, so that a definite number could come to America each year to enter our schools and colleges.

Possibilities for American Trade in China

To illustrate in a small way the possibilities of trade in China, I understand that in 1919 the Baldwin Locomotive Co., built sixty-two locomotives for China. On April 1, 1920, the American Locomotive Co. closed a contract for twelve passenger locomotives, the largest and most powerful in the Far East; on February 1, 1920, the American Locomotive Works closed a contract for twenty Mikado type engines, duplicating ten of the same type furnished in 1919. The first consignment of ten heavy freight locomotives has arrived in China. The Peking Fuiyuan Railway has purchased three Mallet and five Mikado type locomotives built by the same company.

China is at the present time importing a large number of airplanes, and airplane mail routes are being established. The automobile imports have increased enormously, and road making and textile machinery are in great demand. Telephone and telegraph lines are being extended. The government is purchasing machine tools for the arsenals and schools, and is rapidly learning the advantages of having machine shops connected with school work. All of this means an outlet for American machine tools and a future market that should not be overlooked. China has an abundance of coal, iron, and minerals, and with the rapid stride toward modern methods within the next ten years is certain to become a large purchaser of American machines.

The First Steps for Developing Chinese Trade

Frank A. Foster, an American mechanical engineer of 29 Branch Ave., Eden Park, Auburn, R. I., has assisted in the placing of some American machine tools in schools in China, and his long residence there makes him familiar with the situation. Mr. Foster expects shortly to return to China with the idea of possibly establishing a machine shop or a machine tool agency and will gladly cooperate.

The present administration at Washington has expressed a willingness to cooperate with the American manufacturer for the extension of our foreign trade, and it is therefore incumbent upon us as manufacturers not only to place in our shops as many of these students as we can conveniently employ, but also to assist in the complete equipment of machine shops in connection with schools in China.

INDUSTRIAL CONDITIONS IN CUBA AND MEXICO

By E. H. FARRELL, Foreign Representative of Sidney Industries, Sidney, Ohio

At the request of the editor of MACHINERY, the writer, having just returned from a business trip to Cuba and Mexico, will give in the following paragraphs, a brief review of the conditions as he found them in these countries, dwelling particularly upon such information as has a bearing upon the export trade in machine tools.

In Cuba, business is very much disorganized and all that can be said is that the general reports that have come to the United States concerning the difficulties there are correct. Nearly every importer of machine tools has overbought considerably, and the Cuban sugar crisis made it impossible for them to sell anything like a normal amount of equipment. Consequently, there are several hundred thousand dollars worth of machine tools in the warehouses of the machine tool importers, with very little hope of moving any of it for some time to come.

While most of the firms are sound financially, they are unable to pay immediately for equipment that they have bought, and it has been necessary to extend the time of payment. Very likely it will be from one to two years before Cuban buyers will be able to take care of their obligations in full, and probably two years before any considerable amount of machine tools will be imported again, as the stocks in the hands of importers and dealers are sufficient to take care of the normal requirements for at least that length of time.

Conditions in Mexico

In Mexico City, the writer found conditions just the reverse of the reports current in the United States before he went there. It seems that considerable propaganda has been spread in the United States advising manufacturers that now is the time to become firmly established in Mexico, and while missionary work at this time is not altogether lost, it cannot be said to be profitable, because importers of machinery are not in a receptive mood.

Money is scarce in Mexico, and it is difficult to borrow. Such banks as lend any money at all charge from $1\frac{1}{2}$ to 2 per cent per month with the very best of security. The price of silver is very low and practically all of the mines are closed. The railways are in a deplorable condition as far as rolling stock is concerned, and a very large portion of the freight moved over the Mexican lines is transported by privately owned equipment and privately owned locomotives and with much delay. The railway conditions between Vera Cruz and Mexico City make it very difficult to get goods to the latter point, and while the dock situation in Vera Cruz has improved slightly, it will be several months before the docks are cleared of merchandise on account of the inadequate railway facilities.

Primarily, Mexico requires investment of outside capital to develop her resources, and until the present government in Mexico has been recognized by the United States, foreign capital will not be eager to enter the country. The government has very little money with which to buy, but is making a great effort through taxation to rehabilitate the federal treasury.

Incidentally, it may be mentioned that German firms are flooding Mexico with catalogues and price lists, and undoubtedly will claim a good share of the business there if Americans do not put in a strong bid for it as a nation.

* * *

American demand for automobile tires has grown from about 6,275,000 tires in 1913 to over 34,000,000 tires in the year 1919. Approximately 60 per cent of the india-rubber consumed in the United States in 1919 was used for tires as against 58 per cent of the imports for 1913.

MAY, 1921

MACHINERY

VOL. 27 NO. 9

Published Monthly by
THE INDUSTRIAL PRESS
140-148 LAFAYETTE ST.
NEW YORK

ENGLAND
51-52 CHANCERY LANE
LONDON

CABLE ADDRESSES
MACHINERY, NEW YORK
MACHTOOL, LONDON

ALEXANDER LUCHARS, President
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EDITORIAL
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Associate Editors

A DEPARTMENT OF ASSISTANCE TO BUSINESS

Unfortunately, for many years, the attitude of the government of the United States toward business has been principally that of regulation and repression. The new Secretary of Commerce has a broader view of the functions of the government in relation to the service it can and should render business, and believes that there are some services that can be adequately handled by no other agency than a government department. He believes the Department of Commerce can be transformed into a Department of Assistance to Business, provided business will cooperate with the department and bring pressure to bear upon Congress to make adequate appropriations for such work as the department can undertake to aid business.

The name of Hoover is one to conjure with, and when the industries realize what he proposes to do they should send him helpful suggestions and make every possible effort to secure for his department adequate appropriations for the work proposed.

The appropriation for the coming fiscal year for the Department of Commerce has already been made, but doubtless Mr. Hoover will request an additional modest amount —perhaps about one-tenth of one per cent of what has been appropriated for the Navy. Industry and commerce are entitled to consideration and encouragement, and they will receive them if manufacturers generally will stand back of Mr. Hoover in his efforts to serve them.

As soon as the Secretary makes his request for an additional appropriation every manufacturer who believes that the Department can be more helpful under his leadership than it ever has been, should write to the chairman of the Committee on Appropriations of the House and also of the Senate as well as to his Senators and Congressman, pointing out the necessity for such an appropriation if the Department is to be of real value to the industries.

* * *

MACHINE TOOL PRICE COMPARISONS

Machine tool manufacturers whose prices have been advanced conservatively during the past six years find it difficult to meet the demands now made for price reductions, by both dealers and possible customers. When conservative reductions are made, they are often compared with reductions in a different line, not only of machine tools but of general machinery.

To institute a fair comparison, 1914 prices should be considered. Some manufacturers have increased their prices less than 100 per cent since 1914; others from 100 to 170 per cent, and the reduction should be in proportion to the increase. If one manufacturer has reduced 10 per cent and the maker of a different line 25 per cent, the natural impression often is that the former is holding up his price unjustifiably; but this assumption may be erroneous.

As has been pointed out frequently in MACHINERY, and especially in the article "Machine Tool Prices" on page 527 of the February number, average machine tool prices are not high when the improvements made in the past seven years, the increased cost of materials and the high cost of labor are considered. Nevertheless, machine tool builders are making reductions in their prices wherever possible. If these reductions are not as great as the buyer sometimes looks for, especially as compared with other machinery lines, he should take into consideration the relative increases that have been made since 1914, the figures for which are readily obtainable.

* * *

WAGES AND COSTS

One of the most prolific causes of misunderstanding between workmen and their employers is the misconception on the part of the average workman of the relation of wages to total costs. Employers are mainly responsible for this lack of understanding of a fundamental and vital economic principle, because, in the past, they have done little or nothing to educate or inform the workman of the fact that his wages constitute but a small part of the total cost of the product. Men familiar with the attitude of the shopman know how often expressions like this are heard: "I hear that the company charges $54 for that tool. It took me only thirty-two hours to make it and at $6 a day that is $24. Some profit!"

The workman, and sometimes even foremen and minor executives, fail to realize that in addition to wages the selling price of a tool or machine includes the cost of material, rent and taxes on the factory, state and federal business taxes, interest and depreciation on the plant, fire insurance, liability insurance for accidents to employes, salesmen's salaries and traveling expenses, and salaries for the necessary officials, superintendents and foremen who manage and supervise the work; and, unless the product is sold direct, there is a discount to jobber and retailer, as well as many other items included in the elastic expression "overhead." The total of all these items is usually greater than the wages paid the workmen.

One of the largest manufacturing companies in the country recently prepared a chart which it distributed to the employes, showing that wages, in the company's plants, are only 40 per cent of the total cost of the product, and giving, by percentages, accurate information as to all the other costs involved in operating the plants of the corporation. The arguments of political and labor agitators can best be met by statements of fact; and information of this kind is of great value in exposing their unsound economic doctrines. Secrecy has been one of the main causes of friction between employers and employes. The workman, ignorant of business procedure, usually exaggerates the profits made by his employer and the income of the men at the head of the corporation. The company referred to, which has taken its workmen into its confidence and given them definite information relative to costs, holds an enviable record for the number of employes who have been in its service continuously for long periods.

Observations During a Trip to Europe

By DONALD C. WATSON, Vice-president, Universal Boring Machine Co., Hudson, Mass.

The author of this article returned from a trip to Europe two weeks ago. He has summarized the conditions in Europe as he saw them during his travels in France, Belgium, Germany, and England. He deals especially with the conditions in the machine tool field on which he became well informed through men who are in close touch with those conditions. The European situation presents so many difficulties that Mr. Watson's views, based as they are upon recent observations, should be of value to every manufacturer interested in export trade.

HAVING just returned from a visit to France, Belgium, Germany, and England, I believe that some of the conditions I found there would interest those engaged in the manufacture and marketing of machine tools in the United States. Far more important than details affecting the machine tool industry are certain conditions that affect general business. I expect that there will be little activity until the Russian situation is settled, because all workmen have their eyes on the success or failure of the "Soviet Regime." One large steel manufacturer told me that he could tell better the current state of affairs in Russia by going out into a shop than by reading the papers. It can be readily seen that the people will not undertake any great enterprise until this condition is settled. I met no one who ventured to predict when the present state of Russia would end. The best informed seem to be divided in opinion as to what form the end would take. One view was that it would take the form of famine, and be a general starvation process, which would end in the fall of some year through the fear of the coming winter. None ventured to name the year, although none put it more than two years away.

The other view was that the original form of soviet government as conceived was already being found futile. As a result the government would gradually swing back to encouraging individual effort rather than "Communism." This would be a slow process, but would eventually evolve through recognition of individual ability into a government that would recognize the right of individual ownership, either materially or mentally, thus giving individuals their proportionate reward.

The Payment of the German Indemnity

The other element to consider, is the German Indemnity. Individuals in France, particularly, placed with their government their own securities, which were used by the government as collateral for loans. For these they received only a slip of paper, stating that so much had been deposited. It is necessary for the government to obtain the German Indemnities to pay this money back. Besides this, all governments have been attempting to take care of their men released from their vast armies, by giving them artificial employment on the railroads, highways, housing, and kindred work for the good of the community. This great burden, coming as it does on top of the war, makes it imperative that the Indemnity must be paid and paid promptly. These are only a few instances to illustrate this great need; besides there is the external foreign debt owed by each government.

These conditions have led to the governments attempting to get enough money to enable them to finance the needs that confront them. Severe measures of taxation have been adopted, and will have to be continued until something has been paid by the Germans. The British per capita tax is 28 per cent, the French 18 per cent, and the German 12 per cent. These are very heavy, as compared with our own tax of 8 per cent. As you can readily see, with this burden individuals can lay nothing away in the way of capital for new business. Until these taxes are reduced, I cannot see a growing purchasing power to start business of any volume.

France and England have found that they cannot get the Germans to admit their responsibility for the war. The Germans' attitude is one of seeing how much they can get off, rather than studying how much they could pay; therefore, the Allies have adopted a slow process of occupation to change the Germans point of view. Every day that we refrain from traveling side by side with France and England in this process, we are putting off the German change in view, because I found a strong sentiment existing in Germany trusting in the United States to decrease the size of the Indemnity. If we do feel that way, the present course is achieving that purpose. However, if we feel that war debts should be paid, we must take an active part in seeing that they are paid.

Present Outlook for American Machine Tools in Europe

The more detailed facts concerning our ability to market American machine tools in England and the Continent are as follows: With very few exceptions, I found dealers in France, Belgium, and England with a large stock of all varieties, for which they paid very high prices. Many of these were ordered to be paid for in foreign currency, when foreign currency was higher in relation to the dollar than at the time when the bill was paid. They have lost a large amount of interest on money tied up in this way, and as it appears that things will be quiet for some time to come, it looks as if they would lose a good deal more.

They are also competing against new goods that are being marketed at lower prices, as well as a tremendous number of auctions of machine shop equipment, which is selling at ridiculously low prices. In addition, they are competing against equipment bought by their own government for war and restoration purposes, which is now offering tools of all our best makes, both new and second-hand, at 60 per cent of the price that dealers can afford to sell them for with a 10 per cent profit. These governments are also selling on far easier terms than dealers can afford to offer. I have a book before me that has for sale 994 almost new tools, and 117 new tools. These are of all makes and constitute a very representative line. This is merely one list among many.

German Competition in Machine Tools

The dealers are also competing against German machine tools, which in many instances are exact copies of American machine tools. Some of the best are beautifully built and are of high quality, but others are not well built. Making a broad statement, I would say that the equivalent of an American tool may be sold in France and Belgium at 40 per cent of our prices. They may be sold in England at approximately 55 per cent of our prices. One can see even with sentiment against German competition, that it is very tempting for a buyer to put in two German tools for the same money that he could put in one American tool for. I was told that the Germans were making good

profit at these prices, but I take this merely as hearsay, because I do not actually know.

I went to the Industrial Fair at Leipzig and saw there 122 machine tool manufacturers exhibiting. Many of the German war plants are now making machine tools that resemble closely American tools that they had in their shops. German tools are marketed at their factory at approximately the equivalent of 19 cents per pound. For your own amusement figure your price on this basis. Often, but not always they are sold under rules laid down by an organization of machine tool manufacturers. They are paid at least one-third with the order, one-third at the time of shipping, and the remainder according to agreement between sellers and buyers. Their prices are usually F. O. B. factory, exclusive of packing.

The purchaser is not allowed to cancel a contract, unless through delay in agreed upon delivery. The supplier is not allowed to recede from his contract, unless the purchaser is tardy in his payments, or unforeseen events, such as "acts of God, war, fire, flood, etc." In case of increase in wages or material the supplier has the right to abide by the contract, but charge a corresponding increase in the price originally agreed upon. The purchaser pays for the seller's erectors, traveling, and waiting time. The purchaser has to provide at his own expense the necessary masons, carpenters, etc. The manufacturer guarantees his machines against faulty material or workmanship for six months, or three months used on two shifts. Many dealers in France and Belgium handling American tools also deal in German tools, and are making sales, which they cannot do with American tools. They are confronted with a problem of keeping their organization together, and this is the only way they can do it. They do not like to sell German tools, but if they do not, someone else will, and I think they are justified in their view.

English Machine Tool Competition

In regard to competition with English machine tool builders, it is evident that henceforth it will be very keen. Their prices are not much lower than ours. Before the war this would not have made enough difference to stop marketing our tools. The English, however, during the war have learned a great deal about machine tool manufacture. I believe the resulting improvement in design and workmanship will make them keen competitors in certain lines.

Future for American Machine Tools

In regard to the tools sold by our War Department, I saw some of them in use, others are still at the debarkation ports. Many were lacking certain attachments, wrenches, etc., which have caused customers much inconvenience.

I am not at all pessimistic for the future of marketing our tools abroad, but there is a deadlock at present which may take some time to straighten out and to absorb the machines on hand. I found everywhere that American tools were greatly admired, and we must all do everything in our power to retain our high reputation for workmanship, finish, convenience, appearance, and above all accuracy. These principles will certainly tell above everything else in our foreign market. We must not sacrifice any of these qualities for price, but I do feel that prices must be lowered to help counterbalance the premium of the dollar in exchange. I believe that it will pay to publish some catalogues or circulars in foreign languages, particularly in French or Spanish.

It certainly will pay to make sure our packing is strong enough. If we can safely quote prices C. I. F. and at a definite rate of foreign exchange, it will aid. This is a great help to dealers, as it allows them to quote their product to a customer at a specified number of pounds or francs. The rate of exchange is so rapidly fluctuating that it is very difficult for a dealer to quote, except for immediate acceptance in foreign money.

QUALITY VERSUS FIRST COST IN MACHINE TOOLS

By W. C. McCONNELL

Commenting upon the article published in the March number of MACHINERY, entitled "Quality Versus First Cost in Machine Tools," the writer wishes to state that the reason why many purchasing agents are inclined to consider only the first cost in purchasing machinery, when a better grade of machine at a higher first cost would be cheaper in the long run, is due to the tendency present everywhere toward self-exploitation at the expense of the general welfare of the business. The purchasing agent hopes for promotion. To attain this, he must present a record in cold figures of having been able to purchase advantageously, even though he knows that the better grade of machine will be cheaper in the long run. He likewise knows that if figures show that he has been able to purchase cheaply he will probably be promoted long before the machine wears out or gives trouble; while if the figures show that he has paid a higher price for a machine when one that appears to be just about as good could have been purchased at less cost, he may fail to impress those to whom he is responsible with his value.

This same condition often exists in the shop. A foreman was once criticized by an employe because of permitting certain work to be done in a manner that did not seem to be to the best advantage of the company. He replied, "This way makes a better showing for our department." I have seen a machinist pick up a shop broom—a perfectly good broom—and saw off about a foot and a half from the end of the handle in order to obtain a piece of wood that he needed to do his work quickly. It made him look like a speedy man, but it made it very inconvenient to sweep with that broom ever after. Another machinist sawed off a drill shank to use it for a dowel-pin in order to get his work out quickly.

At one time the writer was employed in a street railway shop. A great many railroad motors constantly came in on account of electrical troubles. He suggested that the armature shafts and bearings should be more carefully attended to, which would do away with a great deal of the electrical troubles met with. This was done, and the total maintenance costs were greatly reduced, but the writer was discharged from his job because he had spent more time on each motor than had previously been spent.

The great difficulty is to introduce such conditions both in our offices and shops as will convince every man that if he works solely in the interest of the business in which he is engaged, cooperating with everybody, his own best interests will also be served. The men on the lower rungs of the ladder cannot be made to realize this unless those who manage are willing to investigate details carefully, in order to learn when apparently increased costs mean savings and vice versa.

* * *

GERMAN TRADE WITH SWEDEN

According to a U. S. consular report from Sweden, advertisements frequently appear in Swedish newspapers and journals indicating that German manufacturers are ready to assume trade relations with Sweden. These advertisements cover a large range of goods, including machinery of all classes. The conditions of the German railroads appear especially favorable, as it requires only from ten to twelve days for the delivery of freight in all parts of Sweden from Germany by way of the Sassnitz-Trelleborg railway ferry. American goods shipped by way of Gothenburg are delivered in Germany and Austria within fourteen days after leaving the latter port. The gradual resumption of trade between Germany and Sweden is causing uneasiness in Swedish manufacturing circles, and the demands for higher tariffs are heard on all sides.

New Design of Die-sinking Machine

Billings & Spencer Die-sinking Machine Embodying Many Features Formerly not Incorporated in the Design of this Class of Machines

A NEW die-sinking machine, designed by B. M. W. Hanson, has been brought out by the Billings & Spencer Co., Hartford, Conn. This machine embodies in its design several noteworthy features, among which are particularly noticeable the wide range of work for which the machine is designed, its adaptability both to low and high cutter speeds, the method of holding and clamping the shanks of the cutters, the narrow guide principle as applied to all slides, the arrangement of all handwheels and levers so that they can be reached by the operator when standing in the operating position at the front of the machine, the method of transmitting power from the main driving pulley to the spindle, and the rigidity of the machine, due primarily to the design of the column.

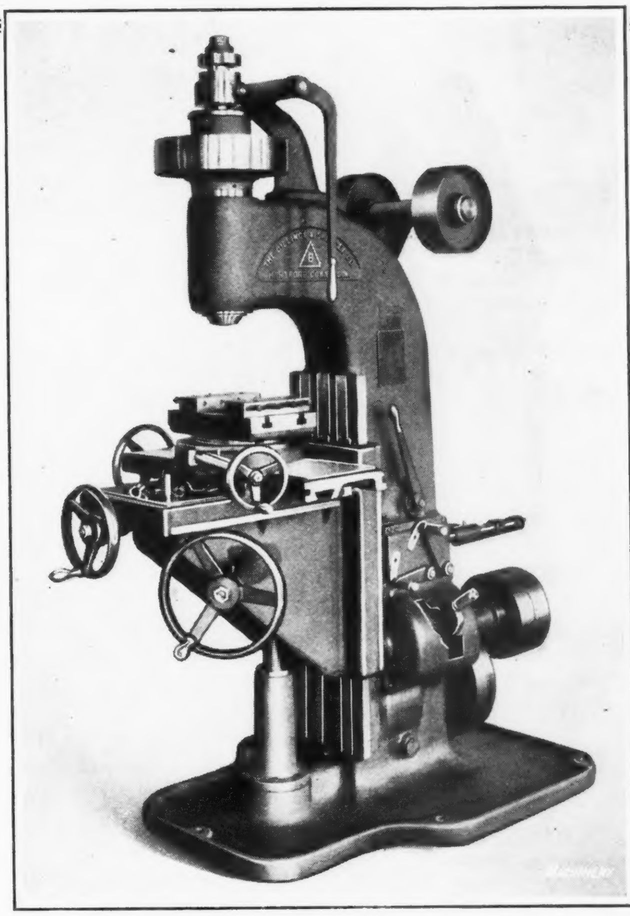

Fig. 1. Die-sinking Machine brought out by the Billings & Spencer Co.

Main Driving Features

The drive to the machine is by means of a belt operating on a fast and loose pulley. A belt shifter is provided as shown in Fig. 1, operated by a handle on the side of the machine. The shaft on which the belt shifter handle is mounted extends through the column of the machine and there is a handle on the opposite side as well, so that the belt shifter may be operated from either side of the column. A friction is provided in connection with the belt shifter so that it may be placed in any position desired—that is, the driving belt may be brought either full on the tight pulley or may be brought partly over and held in a position where it is only partially engaged on the driving pulley, while part of it still remains on the loose pulley. In this manner, a drive is provided for cutters like cherrying cutters, applicable according to the judgment of the operator, so that when "cherries" are employed and only a portion of the face of the driving pulley is engaged, the belt can still slip before the shank breaks, should it encounter an unusual resistance. This is an important consideration in a die-sinking machine where sometimes "cherries" with small tangs are employed and at other times heavy end-mills.

A gear-box is provided for obtaining the different spindle speeds. Through double back-gears and a tumbler gear, sixteen speeds of the spindle are obtainable varying from 11 to 1133 revolutions per minute. A simple clutch arrangement, as shown in Fig. 4, is provided for transmitting power between the gear-box and the spindle driving pulley, the object being to provide a means whereby the main driving pulley and the gear-box may be stopped almost instantly, although the momentum of the moving parts of the spindle and its driving

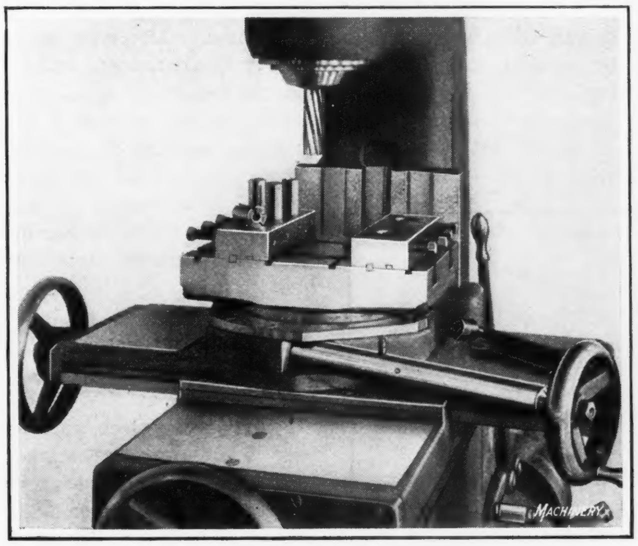

Fig. 2. Slides, Swivel, and Vise of Die-sinking Machine; this View also shows Collets for holding Tools

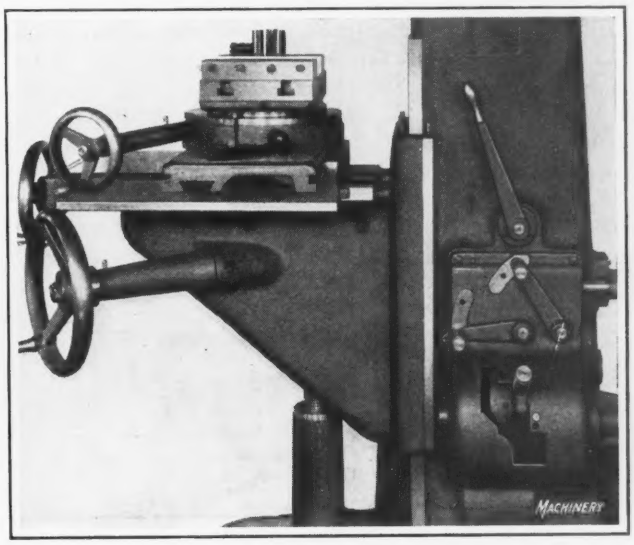

Fig. 3. Side View of Machine showing Gear-box and Levers, and Narrow Guide and Square Locks of Slide

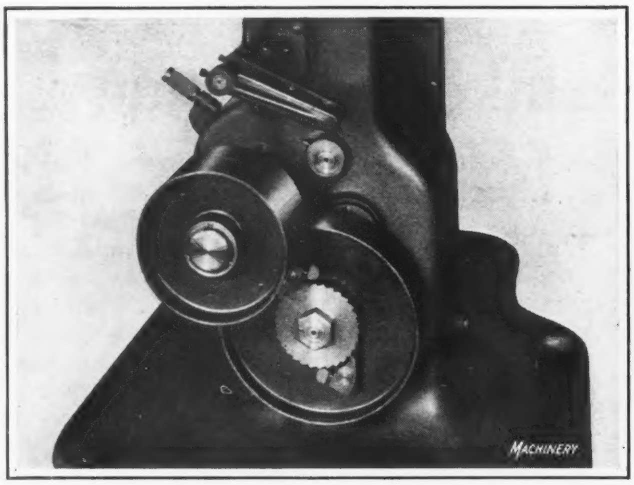

Fig. 4. Pawl and Ratchet Arrangement for transmitting Motion from Gear-box to Spindle Driving Pulley

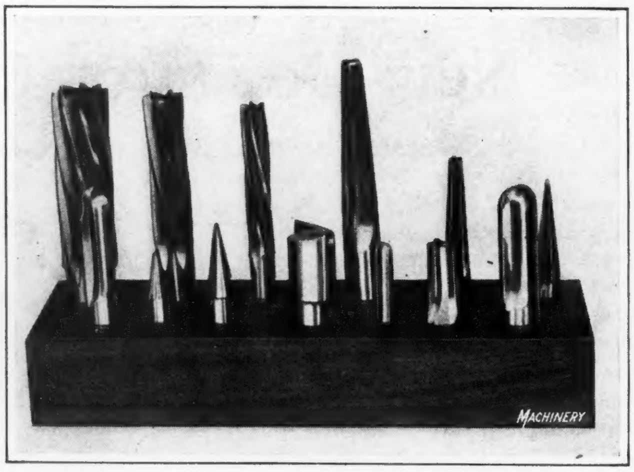

Fig. 5. Typical Collection of Tools which are used in Die-sinking Machine

pulleys and idlers continues to move the spindle. This clutch arrangement is simply a ratchet gear with two pawls. The drive from the gear-box revolves the ratchet gear, which, in turn, operates against the pawls and thereby transmits motion to the spindle driving pulley. When the main driving pulley is stopped and the gear-box and ratchet wheel also stop, the pawls can continue to slip over the ratchet. In this way speed changes by means of the gear-box may be made instantly, even though the spindle and its cutter have not been brought to a full stop.

The spindle runs in double ball bearings at the lower end, and is provided with a single ball bearing at the top. The driving pulley at the top of the spindle runs on independent ball bearings, so that the pull of the belt does not come directly on the spindle. The idlers at the rear of the column, the spindle driving pulley at the back of the machine, the main driving pulleys, and the gear-box shafts also run in ball bearings.

Chuck for Holding Cutters

One of the new features embodied in this machine is the special chuck employed for holding the cutters. The chuck is so arranged that it will hold, firmly, cutters with a straight shank not more than 1¼ inches in length. This permits of a considerable saving in cutter expense, as it eliminates the use of a long taper shank, using a large amount of high-speed steel. The chuck, as shown in Fig. 6, is provided with four jaws that bear against the straight shank along its entire length, the outside of the jaws being acted upon by the tapered surface of the spindle sleeve, which forces them inward when the chuck-actuating handle, shown on the side of the upper part of the machine, is manipulated. The chuck holds cutters with a shank diameter of 1 inch; and by the use of four hardened and ground bushings, which can be inserted in the chuck instantly, tools having shanks ⅜, ½, ⅝, and ¾ inch in diameter can be used interchangeably. The clamping and releasing of the tools and bushings is done in an instant by operating the chuck-closing handle. No wrench is required for removing or clamping tools, and taper shanks on the tools are eliminated.

Knee, Slides, and Swivel

The knee is mounted on the column by means of a square narrow guide in the center of the column of the knee and square locking strips at the sides of the column. The elevating screw for the knee is provided with a ball thrust bearing. Both the longitudinal and the cross slide are provided with a narrow dovetail guide with square locking strips at the edges. (See Fig. 3). No loose gibs are employed anywhere in the machine. The narrow guide principle, in conjunction with the square locking strips at each side of the slides, provides for a full bearing surface across the full width of the slide and prevents the binding action often found in the case of wide dovetail slides. In addition, the width of the slides has been made ample, in order to introduce the necessary rigidity.

The swivel is designed in such a way that the worm engaging with the worm-wheel attached to the swivel is adjustable for wear. Lines are provided both on the longitudinal slide and on the cross-slide, with corresponding lines on the cross-slide and on the knee, so that when these lines coincide, the center of the spindle will be exactly over the center of the swivel. In this way, micrometer readings taken on the micrometer dials provided on both the longitudinal and cross feed screws make it possible to obtain exact settings of the swivel center from the center of the spindle; and it is possible to mill grooves or contours at exactly predetermined radii.

The jaws on the vise can be placed in three different positions, square keys being provided for holding them in place. The clamping screws in the jaws are slightly inclined toward the center to provide for proper binding action. The handwheels and levers are all so placed that the operator can have the work in full view while reaching for any of them. The handles on all the handwheels are free to revolve with the hand, and the shape of the rims has been specially designed with a view to permitting a firm and comfortable grip to be obtained. All screw heads have been proportioned so that only two wrenches are required for use in connection with the machine.

The column design is noteworthy in that on the inside it is ribbed both longitudinally and crosswise to produce great rigidity without excessive weight. There are eight vertical ribs running from the bottom of the column upward and curved into the bent portion; and horizontal cross-ribs provided at intervals give stiffness in the other direction. The column and the base at the bottom are cast in one piece, and the base is cut away at the front to provide ample space for the feet of the operator as he stands in front or slightly to one side of the machine.

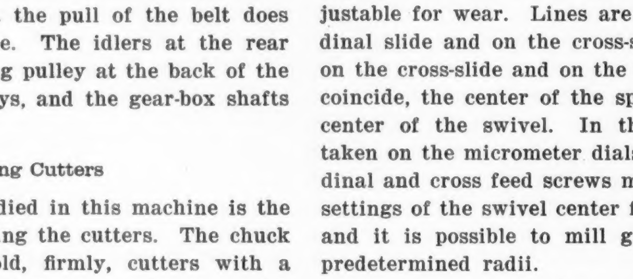

Fig. 6. Construction of Chuck for holding Cutters with Short Straight Shanks

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, April 14

AT the time of the present writing, British industrial conditions are in such a chaotic state that it is impossible to give either an accurate interpretation of present developments or to undertake to forecast the outcome of the strikes and the threats of strikes that paralyze the country. When this letter is printed, newspaper accounts will have given the readers more recent news. All that can and should be done in a letter of this kind is to review the machine tool industry up to the beginning of the present serious difficulties.

It is natural that any indication of a recovery in the machine tool industry should be considered as a herald of improvement in trade generally, and as at the present time a brighter tone than has been apparent for many months is evident in some sections of the machine tool trade, the optimism of the sanguine as regards the present year's general trade may be justified. A few makers of the larger types of machine tools are fully occupied. In the Lancashire and Yorkshire districts several firms are maintaining their plants on full time and even overtime has been mentioned. Inquiries have been received for horizontal boring, facing, and milling machines, but the heaviest demand at present is for machines for locomotive and constructional engineering shops both at home and overseas. For the first time for many months the small tool trade shows signs of weakening.

The general engineering trade is quiet, and the shipyards, although full, are not booking new orders, so that the position in twelve months' time is not expected to be so good. The machine tool industry is vitally interested in the shipbuilding position, as in this trade there are very large buyers of the best types of heavy machine tools.

The facilities for manufacturing locomotives have greatly increased, but there is still considerable difficulty in competing with American and continental makers. Recently a large order for locomotives for the British colonies was given to a German concern quoting £400,000; this represented a figure two-thirds of that at which British firms were able to quote. At the same time locomotives are being made for China, India, New Zealand, South Africa, and various of the crown colonies.

The automobile industry continues dull due to the expectation of a fall in prices; while quite a number of makers have announced price reductions, others have remained silent, which has caused a general postponement of orders. The Austin Motor Car Co., Birmingham, is putting the finishing touches to its body press shop, and will shortly be able to produce body back ends at one stroke of the press.

Overseas Trade in Machine Tools

The official returns for January of this year show that the imports of machine tools are down to about one-half and exports up to over double the tonnage of January, 1920. This proportion is no sudden condition but the result of a general improvement shown steadily during last year. A pre-war monthly average import of machine tools was 276 tons at a value of £96 per ton. At present, the monthly average is 755 tons at a value of £256 per ton. Exports before the war showed a monthly average of 1276 tons at a value of £61 per ton, and present exports average 2800 tons per month at a value of £183 per ton. The ratio of imports and exports of machine tools has now reached £100 to £206, but all value per ton figures must be considered together with the fact that after six years of improvements in design and manufacture every ton of machine tools represents a greater intrinsic value. As far as individual machines are concerned, lathes show an overwhelming preponderance of exports over imports, being about seven times as great in value or four times numerically. The only classes of machines in which imports are in excess of exports are power presses, and punching and shearing machines, the discrepancy being about three times, when values are considered.

During February both the exports and imports of machine tools showed a decided falling off, the latter amounting to little over 400 tons in weight and £125,000 in value; these figures are lower than at any time since 1914. Exports recorded were a little over £300,000 in value, the tonnage being only 2000; these figures are lower than any recorded since last June. Among foreign markets which are growing, may be mentioned Siam; out of a total import of machine tools of a value of £4600 in 1920 a little over £4000 came from Great Britain. The export of drilling machines during February showed a jump, 236 machines being sent out of the country as against 123 imported, while the value of the former was seven times that of the latter. Planing and shaping machines were imported and exported in about the same numbers although the value of the exports was seven times that of the imports. Only the machines enumerated under the title "other descriptions" show a large preponderance of imports.

If inquiries may be taken as an indication, a development of Continental trade would seem to be imminent, and there is a general feeling also that a period of greater activity is approaching so far as the Dominions and Colonies are concerned. The position has been modified, however, by the sanctions made necessary by German policy. Though the space devoted to machine tools at the fair at Leipsic has been occupied entirely by German firms, these were fully representative; the Reinecker concern was a notable absentee, however. An extensive export business was being catered for, and would apparently have been developed, but the Allied conditions of collecting 50 per cent of the purchase money to be paid to the importing countries were made public when the expectancy of business was at its height. Few, if any, exports of German machine tools will now be made, at any rate as a result of the Leipsic fair, and the threatened German retaliation is another factor that may have a depressing effect on Continental trade, even though the threat is not carried out to the full. The fair seemed to show that German machine tool design has not advanced since 1914 to the extent apparent here.

Labor Conditions

The machine tool trade has been suffering from unemployment, although perhaps not to the same extent as most other trades. No general movement with a view to the reduction of wages has taken place as yet, but isolated cases, both in the Midlands and the North of England, are known where definite propositions of this kind have been made. The reduction, stated to have been suggested in one instance is 33 1/3 per cent. Wages in the machine tool trade now bear a high ratio to other costs of production, and the question as to whether they are to be standardized at the present high rate, independent of any falling in the cost of living, has come into considerable prominence. Certain classes of labor during the war obtained an abnormal

value which bears no relation to present conditions, and all workers claim a higher standard of living than in 1914. Attempts at reducing these wages are fraught with great difficulties, but cuts with the consent of the men have been made in the automobile and other trades.

In the case of the manufactured irón and steel trade, the Board of Conciliation and Arbitration has announced an immediate reduction of 25 per cent in the wages of puddlers and other forge and mill workers and Consett steel millmen's wages are to be reduced next quarter by 30 per cent. It is rather curious to note that the malleable and gray casting trade is in the unique condition of suffering from a lack of labor. This may be due in part to the molders' strike that occurred during last year, but the haphazard method of recruiting and training foundry labor for this trade is probably a more dominant factor.

Materials and Prices

In most cases the prices of raw materials have shown a strong tendency to fall of late, and the last month shows a definite reduction. For example, steel at the end of last month selling at £24 a ton is now reduced to £18 per ton. The prices of non-ferrous metals have also dropped, but not to the same extent. The prices of machine tools in general do not show a great reduction, but as an instance of what may be expected in the near future, one firm, C. H. Joyce, Ltd., is selling a novel design of thread-cutting lathe with a swing of 18 inches, which sells with all equipment for as low a figure as £100. Pig iron has been brought down by a number of step reductions to from £9 to £10 in some districts, and crown bars are now £24 to £26 per ton. Business in the iron and steel industry remains quiet. Some of the larger concerns are said to be about to put on the market large stocks, bought against orders since cancelled.

It is expected that the prices quoted will undergo a reduction within the next few weeks. As long as the price of coal is maintained at its present level, there can be little hope of steel and iron productions in this country being sold at prices that will effectively compete with the imported material. There have been cases of Belgian firms purchasing malleable pig iron over here and sending it back in the form of castings at prices lower than we ourselves can produce them. The reductions in the prices of raw materials have had little effect on the selling prices of machine tools, since the proportion of the cost of manufacture that has to be allocated to materials is low, as compared with the labor charges involved.

New Developments

The centerless method of grinding is being used in this country to a great extent. It is not only being used extensively for small pieces, such as crankpins and similar work, but some firms, notably Pratt Levick & Co., Ltd., of Chester, are grinding black bar by this method and guarantee all the bars ground by the centerless method to be, if necessary, within a limit of plus or minus one-quarter of a thousandth inch on the diameter. Ground bars of 26 feet in length are a regular production of this company. Many manufacturers are finding these ground bars of exceptional use, as by their use several manufacturing operations can be avoided. The B.S.A. plant is using the centerless method for grinding black bar for its own use. J. Holroyd & Co., Ltd., of Rochdale, are developing a centerless machine which is expected to be marketed shortly.

The A 1 Mfg. Co., of Bradford, has brought out a new method of electrically welding drum seams. This is in effect a continuous spot-welding process by which the spot-welding operation is carried out successively along the seam, the spots being close enough to form a continuous weld. The firm finds that it is possible to make perfect welds, irrespective of rust or scale, and the cost of sand blasting is avoided. A number of these machines have been supplied to an American firm making carbide drums.

WORK OF THE AMERICAN ENGINEERING STANDARDS COMMITTEE

Although the American Engineering Standards Committee has been actively at work for but slightly more than one year, and much of the time and effort of the committee has necessarily been spent in laying a basis for work the fruition of which will require at least two or three years, yet considerable progress has already been made in the unification of the more important standards and in overcoming the confusion that was being produced by the numerous organizations (more than 100) that hitherto published engineering standards without systematic cooperation among themselves. The committee itself is composed of forty-seven members representing seventeen bodies or groups of bodies, including six national engineering societies, five governmental departments and thirteen national industrial associations. Its function is merely to see that each body or group concerned in a standard shall have opportunity to participate in its formulation which is in the hands of a working committee, technically called a "sectional committee." Each sectional committee is organized by, and under the leadership of, one or more of the principal bodies interested, such bodies being known as "sponsors." Sponsorships have been arranged for the following mechanical subjects which were under way by the beginning of this year: Ball bearings, plain limit gages, gears, machine tools, nut and bolt heads, pipe flanges and fittings, screw threads, and shafting. Those who are interested in the reports that have been issued may obtain copies from the American Engineering Standards Committee, 29 West 39th Street, New York City.

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FOREIGN TRADE CONVENTION

At the eighth national Foreign Trade Convention, which will be held in Cleveland, Ohio, May 4 to 7, the following subjects will be considered: Financing foreign trade, foreign and domestic credits, value of long credits to the exporting manufacturer, commercial education for foreign trade, problems of the export manager, the motion picture in foreign trade, the effect of double taxation on foreign trade, the use and value of foreign news, government service to foreign trade, reasonable policy for American foreign loans, special export problems of manufacturers, foreign trade advertising, marine insurance, banking service for foreign trade, and trade relations with the Far East. All the general sessions will be held in the Hippodrome, and group sessions, as stated in the program, will be held at the Hollenden, Statler, Cleveland, and Winton Hotels. Further information may be obtained from the secretary of the National Foreign Trade Council, 1 Hanover Square, New York City, or from Henry Howard, 207 Chamber of Commerce Bldg., Cleveland. The headquarters of the convention will be at the Hollenden Hotel.

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SUMMER MEETING OF THE SOCIETY OF AUTOMOTIVE ENGINEERS

The 1921 summer meeting of the Society of Automotive Engineers, which will be held at West Baden, Ind., May 24 to 28 inclusive, promises to be unusually successful, 150 members having forwarded reservation blanks within one week after the mailing of the first announcement. The noted British scientist, Sir Dugald Clerk, has accepted an invitation to address the society on the fundamental theories on which the internal combustion engine is based. There will be various technical sessions devoted to the topics of research, fuel, aircraft, farm power, highways, and engineering as a sales stimulus. Another subject to be discussed is the present position of commercial aviation in the United States.

Common Causes of Errors in Machine Design

Influence of Working Environment—Fifth of a Series of Articles

By R. H. McMINN

THE proper design of machines and structures is influenced by their environment during use. Certain features of design may be determined by the peculiarities of the environment in which a machine or structure is used; by frequent changes in the characteristics of a particular location; or by a change in the character of surroundings encountered, due to moving a machine from one place to another. A few variable characteristics of the surroundings of machines and structures will be given for their possible suggestive value in analyzing conditions that may affect design.

Design of Foundations

The design of foundations is affected by the soil in which the foundations are to be placed. For any foundation, the general qualities of soil should be known, to determine the size of foundation needed. For light structures and machines, a knowledge of the kind of soil encountered in preparing previous foundations in the same locality may be sufficient. Heavy structures, however, require that borings be made in the exact spot on which structures are to be erected. The kind, size, and depth of foundation will then be determined by materials encountered when boring. The depth of any foundation may also be determined by the depth of other foundations close to it so that the pressure on the soil beneath it cannot wedge the soil against walls which are on deeper foundations.

If a structure is built on the seashore or on any tributary near the sea, the height of the tide at that locality must be known. Likewise the action of the waves on the lower portion of these structures must be considered. These produce tremendous stresses and also tend to wash away foundations. The probable high water level in any locality where a structure or a machine with a foundation in the earth is to be erected should be known before designing them, and consideration should be given to the methods of drainage required or to preventing certain parts below the water level from having water contact. The depth to which the water in the ground freezes in any location must be known, to determine the minimum depth of foundation allowable, since the bottom of the foundation must be below this frost line.

Power-driven Machinery

The width of tires on vehicles or power-driven machinery is partially determined by the material upon which they run. Thus a tractor that runs on soil must have wheels with a much wider tread than a far heavier locomotive that runs on rails. Increased horsepower needed for vehicles on grades, to overcome gravity, and on curves, to overcome increased friction, must be considered. The effect of a steep grade may have to be considered in its influence on the gravity feed of a liquid from a tank by possibly making the point of delivery higher than the point of supply. Slight depressions or high points are encountered in the smoothest track or road it is possible to maintain. Their effects are partially confined to the lower portions of cars or vehicles by the use of springs. The shocks and strains produced on all parts by unevenness should be considered.

Electrolytic Action

Metal placed in the ground is subject to electrolytic corrosion from stray electric currents caused largely by the rails of electric lines being used as return circuits. Iron and lead pipes, which are frequently placed in the streets near electric lines, are especially subject to serious damage unless this tendency is known and guarded against by special protective means.

Snow Loads and Water Pressures

The weight of snow must be noted in figuring the necessary strength of roofs, and the weight of sleet in figuring the strength of wires located out-of-doors. Water may freeze and thereby exert great pressure, which is sometimes evidenced in broken automobile radiators or water-jacketed cylinders. Again, the depth to which a body is submerged in water determines the external pressure exerted on the body. This limits the depth to which a submarine can safely submerge.

Effects of Moisture

The presence of water greatly decreases the tractive resistance between a wheel and the earth or track. The rusting action of moisture in the air or ground must be recognized so that rustproof materials may be used when required. Dampness affects leather belts, making the use of rubber belts frequently advisable. Moisture tends to break down the insulation of electrical machinery, so the windings must be protected from dampness as much as possible. In fact, water has a deteriorating effect on most materials of construction unless they are suitably coated or permeated with some substance which prevents this action.

Air Resistance and Wind Pressure

The resistance of still air to the moving parts of machinery is not often considered. Yet that still air may offer considerable resistance to parts having a certain form and moving at high speed is evidenced by the airplane which is lifted by the action of the propeller and planes against air resistance. Covering large rapidly revolving flywheels on both sides with light plates has a marked effect on reduction of the air resistance of their spokes. This is rarely done, however, because of its first cost and appearance. In calculating the power necessary to move a vehicle or projectile consideration must be given to the resistance of either still air or wind against which it is forced. The wind exerts pressure on sloping roofs and the sides of all buildings, towers, bridges, or any other structure, and they must be able to resist collapsing or overturning because of this force. Even wires have considerable wind resistance, which is increased greatly when they are covered with sleet. Some machines are located in places where the air is laden with dust and sand, or the operation of the machines themselves may produce this condition. Special provision must be made to prevent the foreign particles in the air from getting into the bearings or other parts of the machine which would be injured by such material. So-called "holes" in the air, met with by aviators, which are probably due to variations in the velocity of the air movement at a certain point, require an additional factor of safety in airplanes due to the stresses produced by a sudden dropping of a plane.

Effects of Temperature

The temperature in which a machine will operate may have an effect upon its performance. The ratings of motors

are based upon a certain temperature of the surrounding air, which will thus produce a known radiation from the motor. A locomotive of a certain size and design used in a mild climate has markedly less capacity when used in a frigid zone due to radiation. The required capacity of the heating system of a building depends somewhat on the severity of the winters of the locality where the building is located. Automobile radiators are sometimes scarcely large enough when working under a continuous heavy load and high surrounding temperature. The difference in horizontal expansion between the material of a structure and the foundation by which it is supported requires that special means be employed to allow for this if the structure is of considerable length. Enlarged bolt holes in the splice bars or rails of a track allow the gap in a joint to vary in width when the rails contract and expand due to changes of temperature. The earth is expanded much less than steel with certain temperature changes and this expansion is taken up by the compression of the materials of the earth. The expansion in a long roof truss or bridge is usually allowed for by sliding or rolling contact at one end or by deflection of a plate by which one end is attached to its support. The stress in wires exposed to the elements is increased when a drop in temperature contracts them and reduces the sag. This is still further increased if this occurs when there is sleet clinging to them and a high wind.

Effects of Altitude

The altitude at which a structure is placed or a machine operates may produce certain special effects. Atmospheric temperature increases about 1 degree F. for each 40 or 50 feet descent below the earth's surface after getting down far enough to be beyond the influence of the sun's heat. The temperature of the air decreases with increase of altitude above the surface of the earth. Oil at a reduced temperature congeals so that the size of pipes in airplane lubrication systems must take this into account. Likewise, water boils at a lower temperature at high altitudes which must be considered in the capacity of airplane radiators. The lifting power of the air is greatly reduced due to its rarefied conditions, involving greatly increased horsepower to sustain a plane at high altitudes. The volumetric efficiency of air compressors decreases with the altitude at which they are operated, because of the more rarefied free air which enters the compressor. The corona loss, due to the breaking down of the air insulation between high-voltage conductors increases with the altitude at which transmission lines are located, so that at high altitudes larger wires must be used for a given voltage.

Location of Machine and its Surroundings

If a machine is being designed with special reference to being located in a certain position in the purchaser's building, a drawing should be submitted to the manufacturer showing the floor space allowed, overhead clearance, and its location with reference to building walls, columns, and preferably other machines which are nearest to it. If the machine is belt-driven, the location of the lineshaft should be indicated on the purchaser's drawing, and any limitations in the location of the drive pulley on the lineshafting should be shown. Sometimes a machine may be built with a pulley on one side or the other to meet special limitations imposed by the need of belt clearance from some object already in place. The means to be used in getting material to the new machine and removing the finished product or by-products should often be known. If a foundry tumbler is to be loaded from both sides, the drive shaft in back is located especially low down so as not to interfere with placing castings in the tumbler from the back. The designer should carefully consider whether the operation of other machines near, the material used in them, or any by-products from them will have any ill effects on the new machine or its operator. It may be necessary to protect either or both from the heat, sparks, steam, or flying particles from another machine. For instance, if a traveling crane must be installed so one end passes over a large reservoir ladle for molten iron, the cage where the operator is stationed should be, if possible, on the other end of the crane to protect the crane operator from the heat radiated upward from the surface of the metal. If there is no simple or practical means to afford protection from another machine in the design of the new one, the purchaser's attention should be called to the necessity of providing some means of protection. All structures subject to special fire hazards from their contents or surroundings should be designed so that they will be suitably protected from this danger.

Ample room should be allowed around a machine for its satisfactory operation, inspection, lubrication, cleaning and repairing, and the purchaser should be advised if the space allotted does not permit these requirements. Any electrical equipment used as part of a machine must be consistent with the kind and voltage of current available, and air-driven devices must not require a pressure exceeding that of the local air distributing system. If the machine rests on foundations separate from the building and yet has some part rigidly connected to the latter, consideration should be given to the result of unequal settling of machine and building. If there is very slight clearance between some point on the building and a part on a machine, considerable settling of the building may bring pressure to bear on the machine part. A serious reduction of clearance may occur even when the weight of the machine is supported on the same foundations as the building, as with a traveling crane supported on a runway attached to building columns. If the clearance between the top point of the crane trolley and the under side of roof trusses is small under the normal load on a rather flat roof, a heavy snow load may cause such a deflection of the truss as to produce interference.

The Machine Operator

One important element in the environment of any machine is the operator. The lack of mechanical experience possessed by the class of labor which will operate the machine may demand that it be designed to reduce to the minimum the necessity for using skill or judgment in operating. The average size of operators may also determine the location of levers and pedals so the operator will have sufficient reach with hands or feet in the position (standing or sitting) that he must assume. The force which can be reasonably exerted by the feet, hands, or fingers in pushing, pulling, or gripping, either constantly or intermittently, must be considered in the design. Suitable clearance must be allowed all around the operator. Armholes and manholes should be large enough to admit the arm or body of a man with the necessary tools and materials to do any work for which these holes are provided.

The weight of any machine like an air hammer, which is designed to be lifted by hand, or even the weight of a hand hammer or the capacity of a shovel must be considered with a view to making it most easily and efficiently handled by an operator.

Any animals that may come in contact with a machine may influence the design of some feature. The National Board of Fire Underwriters' rules for acetylene gas machines state that the hood on the end of the relief pipe shall be constructed in such a manner that it cannot be obstructed by rain, snow, ice, insects, or birds.

Reaction of Machine on its Environment

The effect of a machine itself on the environment in which it will be used must be considered during design. The noise or vibration produced during operation should be kept at the minimum in any machine, but especially in those which are for use in an office or home. The heat necessary to operate or produced during the operation of a machine may bar it for use in certain environments. The

operation of a machine should never require any part of the operator's body to be exposed to either such a high or such a low temperature as to be injurious. Machines should prevent as far as possible the throwing of oil, water, chips, dust, or emitting steam, smoke, gaseous fumes, or disagreeable odors in the air inside of a building. Such results can generally be prevented by the addition of suitable guards or the provision of hoods and piping which connect with an air-exhaust system.

If the machine produces sparks, as motors sometimes do, it may be dangerous to use around inflammable material, such as explosives, gases, or air heavily laden with lint or fine dust. Motors of a flame-proof type are frequently used in mines where explosive gases are encountered. Foundry cupolas are usually provided with an arrester at the top to deflect the sparks downward. Some locomotives in forest territory have special screened stacks with a downward chute attached to one side of the stack near the top to prevent sparks from scattering and starting fires. Sometimes the ill effects of a machine may be the marring of finely polished furniture. Thus, many office machines for use on desks have rubber or felt covered feet.

In starting to design a machine or structure which will be located in an environment with which the designer is not familiar, he should get all the information possible regarding the characteristics of its surroundings.

* * *

Job ticket carriers, blueprint protectors, etc., are generally used in most shops now. They have a transparent sheeting face, and the back is made of leather substitute or rubberized fabric. Experience has shown that the rubberized goods will not stand up well under contact with oil, but that the leather substitute—pyroxylin coated material—is better, since oil and grease do not penetrate the coating unless literally soaked in it.

MILLING SQUARE-STEM PINIONS

The recent improvements in tools, cutters, and various kinds of auxiliary equipment has been no less marked than the improvement in machine tools. In fact, the development of cutting tools that will stand up under higher speeds and feeds may be considered directly responsible for the introduction of machine tools of heavier construction, equipped for higher speeds and feeds than were formerly believed practicable. The notable progress made in designing jigs, fixtures, and tools for use in the manufacture of interchangeable or duplicate parts is recorded in the articles on modern production methods that are published monthly in the pages of MACHINERY. While no important individual features are incorporated in the machine, tools, or fixtures shown in the present article, that have not previously been dealt with in MACHINERY, the article nevertheless deals with a combination of standard and special equipment for squaring pinion stems that is exceptionally well adapted for the work it is intended to do. In the following, a brief description will be given of the work to be machined, the machine used, and the special fixture employed to hold the work.

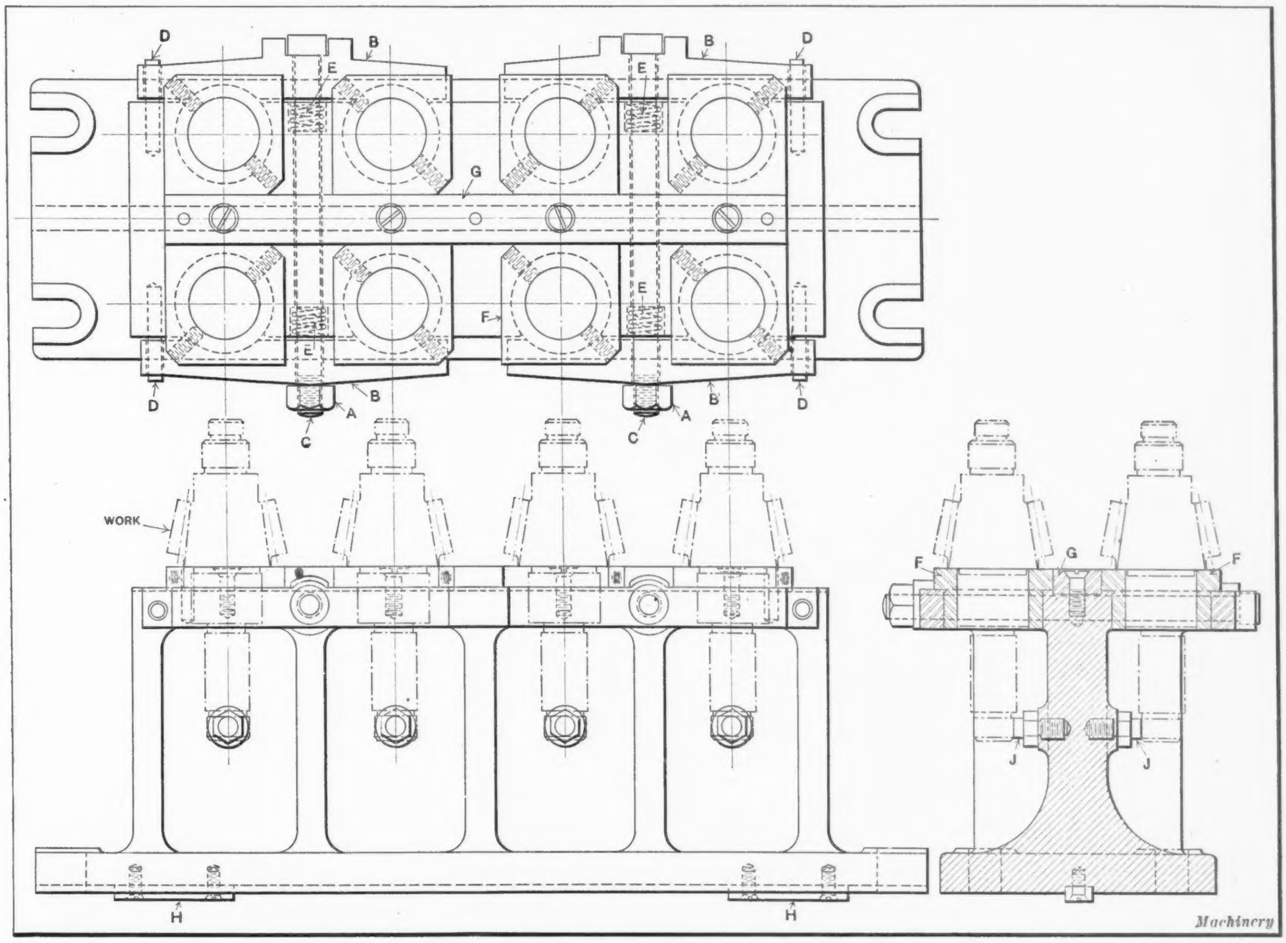


Fig. 1. Details of Indexing Fixture for milling Square-stem Pinions

Machining Operation on Pinion Stem

The work to be done is the milling of the stems of square-stem, nickel-steel bevel pinions. A short threaded stem projects from the center of the small end of the bevel pinion, while a larger stem projects from the back or larger end. There are four sections of different diameters on the larger stem; the first section back of the pinion teeth has the largest diameter and forms a shoulder for the bearing section of somewhat smaller diameter which is next to it. Between this section and the threaded end is the section on which the machining operation is performed. This part is turned concentric with the other sections of the stem previous to the squaring operation, which consists of taking

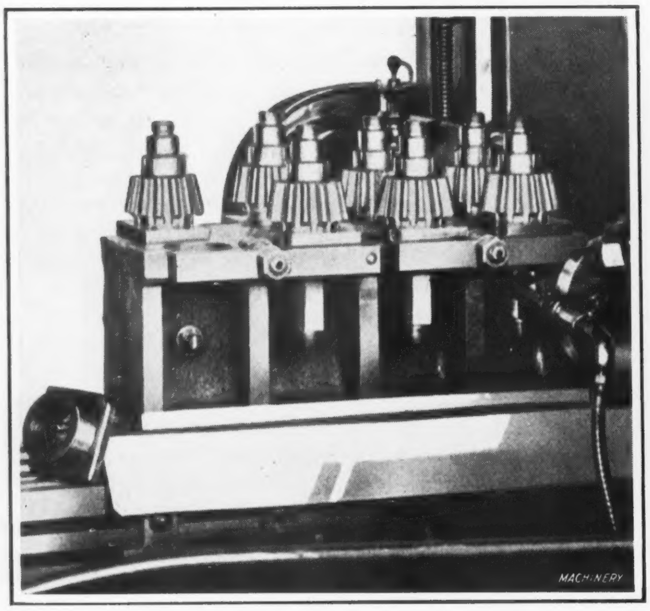


Fig. 2. Side View of Fixture for milling Square-stem Pinions

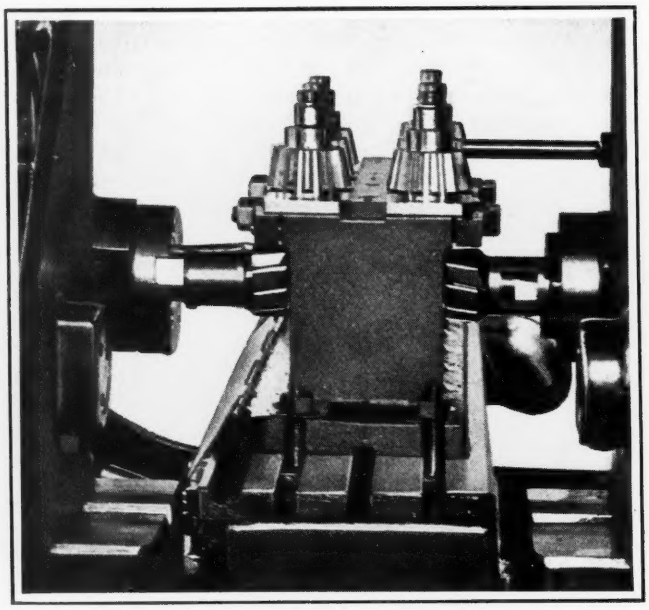


Fig. 3. End View of Fixture, showing End-milling Cutters

four slabbing cuts across the stem, indexing the work 90 degrees after each cut.

The machine employed for the milling operation is a Cincinnati duplex miller. This machine is provided with double opposed spindles mounted horizontally in belt-driven heads which are capable of vertical and longitudinal adjustment. The table on which the work, or in this instance the work-holding fixture, is mounted has a horizontal power feed at right angles to the milling machine spindles. The machine is equipped with a "jump" feed, which aids in obtaining rapid production.

Design of Work-holding Fixture

In Fig. 2 is shown a side view of the work-holding fixture. Fig. 3 is an end view of the fixture, which shows also the end-milling cutters. The design of the fixture is shown in detail in Fig. 1. Provision is made for holding eight pinions, two rows of four each being located side by side, so when the fixture is mounted on the milling machine table and fed past the end-milling cutters shown in Fig. 3, one side on each of the eight pinion stems will be milled. Thus at one pass of the table, cuts are taken on eight pinion stems, equivalent to the machine work required to complete the squaring operations on two stems. After taking the first cut, each of the pinions is indexed 90 degrees and the fixture again fed past the cutters. Indexing the work and feeding it past the cutters four times completes the eight pinions.

To unclamp the eight work-holding bushings *F*, so that they can be removed from the fixture, it is simply necessary to loosen two nuts *A* which serve to clamp all eight bushings and the pinions held in them, by means of clamps *B* held on bolts *C*. These clamps are prevented from turning on bolts *C* by pins *D*, which are screwed into the cast-iron body of the fixture and are a sliding fit in the holes at the ends of clamps *B*. Springs *E* force clamps *B* out of contact with the work-holding bushings *F* when nuts *A* are loosened, so that the clamps do not interfere with the loading or unloading of the fixture.

The indexing of the work is accomplished by means of bushings *F* which fit into the fixture as indicated. One of these bushings is shown removed from the fixture and pinion at the end of the fixture in Fig. 2. These bushings have a square head, one side of which, being in contact with guide bar *G*, Fig. 1, when in place in the fixture, serves as a means of obtaining accurate indexing.

To index the work, it is simply necessary to loosen nuts *A*, raise the pinions sufficiently to permit the square heads of the bushings attached to them to clear guide bar *G*, then give the pinions a quarter turn, and drop them back into position and tighten nuts *A*. By providing sixteen work-holding bushings, the operator can attach bushings to eight unmilled pinions while the machine is in operation, so that the minimum time will be required to reload the fixture. Two headless set-screws are used to hold the pinions in bushings *F*. Keys *H*, held in a slot cut in the base of the fixture, serve to locate the latter on the milling machine table. Adjustable stops or supports *J* for the ends of the pinion stems counteract the thrust imposed on the work by the cutters.

A careful consideration of the construction of this fixture will reveal the following features that are desirable in equipment of this kind: First, the heavy I-section of the casting and the webs or ribs extending from this section at right angles provide unusual rigidity; second, the method of holding the work enables the parts on which accuracy depends to be easily and inexpensively replaced in case of wear or in case slight changes are made in the size of the work; third, the locating or bearing points on the work are accurately machined previous to the milling operation; fourth, two pieces of work being located side by side and backed up by stops *J*, serve to present the metal to the cutters under a condition closely approximating that which is obtained when feeding a single solid piece of work between the cutters; fifth, the construction of the jig is such that the cutting lubricant and chips flow down away from the work, thus leaving it comparatively clean after the performance of the machining operation.

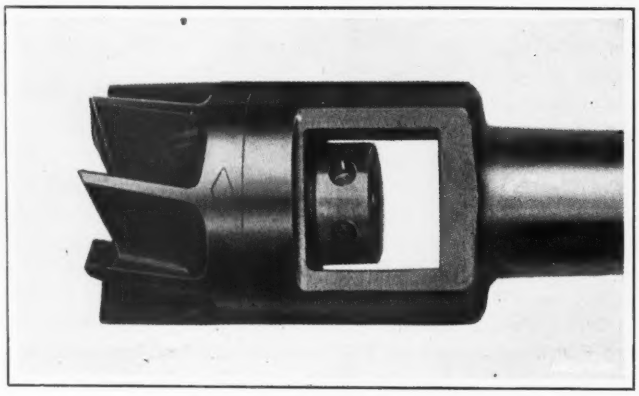


Fig. 4. Chapin & Baker End-mill used for squaring Pinion Stems

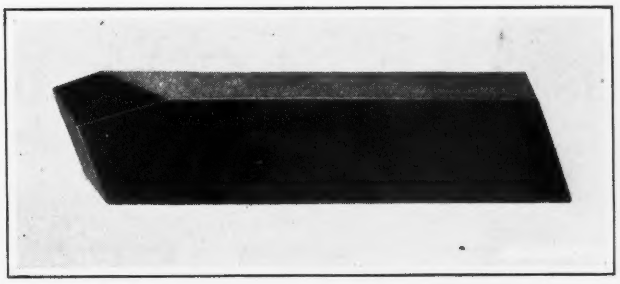


Fig. 1. Stellite Cutter Blade employed on Ingersoll Milling Cutter Heads

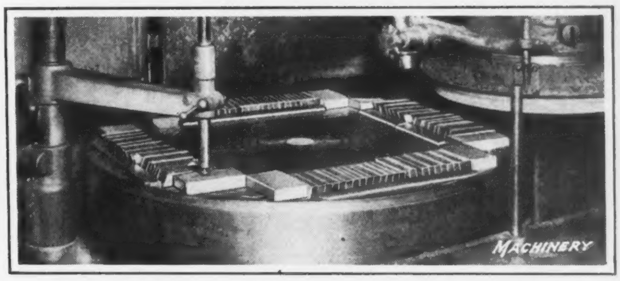


Fig. 2. Vertical Surface Grinding Machine finishing Four Sides of Stellite Blades

Cutting Tools and Speeds

One of the end-milling cutters employed, which is a regular product of the Chapin & Baker Mfg. Co., Syracuse, N. Y., is shown in Fig. 4. Referring to Fig. 3, it will be noted that the cutters are held close to the spindle noses, a feature which enables heavy feeds and high speeds to be employed without causing chatter. These end-mills are 2½ inches in diameter and their design is in a large measure responsible for the results obtained in milling the pinion stems. The cutters are run at a speed of 83 revolutions per minute, and are fed to the work at the rate of 3¼ inches per minute. The production ranges from 40 to 45 pieces per hour, as compared with from 5 to 8 pieces per hour obtained by the machine and tool equipment previously employed. The fixture described in the foregoing was designed by D. A. Lapham, mechanical engineer of the Brown-Lipe-Chapin Co., Syracuse, N. Y., where the equipment is employed.

* * *

MANUFACTURING STELLITE CUTTER BLADES

Interesting grinding methods in use in the shops of the Continental Tool Works, Detroit, Mich., for the production of stellite cutter blades are described in a recent number of *Grits and Grinds*, a publication devoted to the advancement of the grinding art, which is issued by the Norton Co., Worcester, Mass. These stellite blades are used on eleven-inch Ingersoll milling cutter heads. A completely ground blade is illustrated in Fig. 1. The material from which these blades are machined comes to the plant in the form of bars approximately 11 inches long, ¾ inch wide, and ½ inch thick. Each bar is cut into three pieces about 3½ inches in length, the operation being performed on a Racine cutting-off machine provided with a No. 30 rubber-bond alundum wheel, 12 inches in diameter, 3/32 inch thick, with a ¾-inch bore. The production obtained by this machine is about sixty-four pieces per hour and the wheels average approximately fifty-four cuts before they are worn out. Fig. 3 shows the operation being performed, the stellite bar being placed in a holder for bringing it into contact with the wheel, a stop being provided on the holder for roughly gaging the length of each blade.

The stellite pieces received from the cutting-off machine are then ground on a Blanchard vertical surface grinding machine, the blades being placed on a magnetic chuck as illustrated in Fig. 2. Each of the four sides of the blades is ground within a tolerance of 0.001 inch, the quantity of material taken off from each side ranging from 0.010 to 0.030 inch. This machine has a No. 3830-G silicate-bond alundum wheel 18 inches in diameter, with a 5- by 1½-inch rim. The production per hour on this machine averages about twenty-five pieces with the four sides ground. The silicate-bond wheels last from three to four days.

The final operation on the stellite blades consists of grinding three angular surfaces, the operation being performed on a Cincinnati cutter grinder equipped with a No. 3846-J alundum cup-wheel 5 inches in diameter, with a rim 1½ inches wide and ½ inch thick. Fig. 4 shows a blade being held in an angular position in contact with the grinding wheel on this machine. The grinding of the angular surfaces is done at an average rate of about forty-three surfaces per hour, each wheel lasting approximately 1½ hours.

* * *

During the year 1920 freight valued at $1,000,000 was transported by airplane from the United Kingdom in cargo planes to France, Belgium, Denmark, Spain, and Holland. Planes coming into England from the Continent carried $2,000,000 worth of imports.

Fig. 3. Cutting the Blades to Length from Bars by Means of a Rubber-bond Alundum Wheel

Fig. 4. Using a Cup-wheel for grinding Three Angular Surfaces on the Stellite Blades

Comparison of Formulas for Steel Columns

By N. BARNES HUNT, Engineer U. S. Reclamation Service, St. Ignatius, Montana

THE accompanying graphs of a number of the most familiar formulas for steel columns were prepared for an allowable unit stress of 12,000 pounds, in accordance with the recommendation of the special committee on steel columns and struts of the American Society of Civil Engineers, published in the Proceedings of the society, December, 1917.

The committee's recommendation was influenced by a variation of 28 per cent in the strength of the steel and by the absence of definite knowledge of column action. The grade of steel used in the committee's tests is described as having a desired ultimate tensile strength of 60,000 pounds per square inch, which is the strength assumed in preparing the diagrams. The modulus of elasticity is assumed to be 30,000,000.

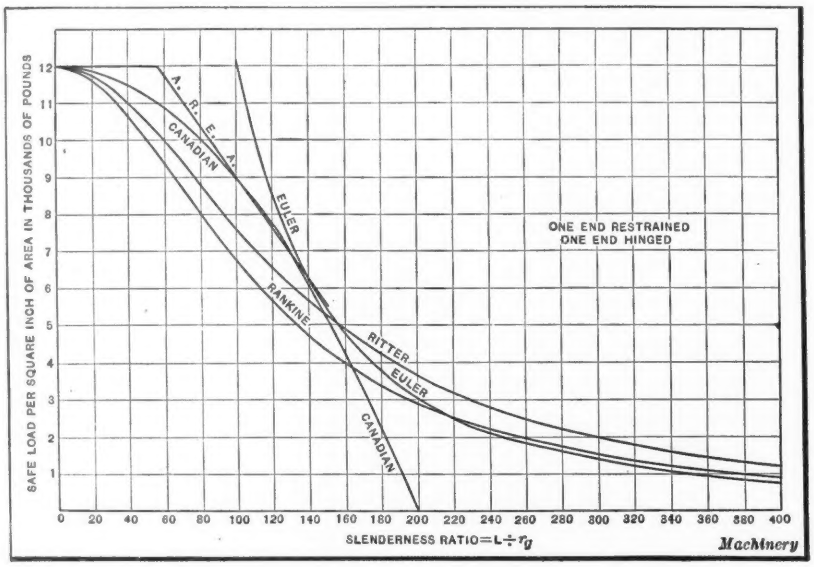


Fig. 2. Comparison of Formulas when One End of Column is Fixed and One Hinged

Terms descriptive of end conditions are often used rather loosely. Assuming that the number may be limited to three, they may be classified as follows to include the terms variously employed:

TYPES OF ENDS

Restrained End	Hinged End	Free End
Fixed	Pin	Unsupported
Square	Round	
Flat	Pivoted	

The types included in any one class may be said to resemble one another to a degree which justifies the grouping, but it is not implied that they are identical. A practical example of a free end is found in some types of gate frames or guides.

Nomenclature

The following nomenclature is used:

P_u = total ultimate load on column, in pounds;
P_s = total safe load on column, in pounds;
A = cross-sectional area of column, in square inches;
S_u = ultimate unit stress, in pounds;
S_s = safe unit stress, in pounds;
S_E = elastic limit;
E = modulus of elasticity;
L = length of column, in inches;
r_g = least radius of gyration, in inches;
C = constant;
C_1 = constant.

The Rankine Formula

The formula $\dfrac{P_s}{A} = \dfrac{S_s}{1 + C\left(\dfrac{L}{r_g}\right)^2}$ is often called Gordon's formula, but may be accredited to Rankine because he substituted the least radius of gyration for the factor of least thickness in Gordon's formula. The constant C is empirical, having been deduced from columns tested to destruction. Merriman's values of C are as follows:

Restrained	$\dfrac{1}{25{,}000}$
Restrained and hinged.. ...	$\dfrac{1.95}{25{,}000}$
Hinged	$\dfrac{4}{25{,}000}$
Restrained and free........	$\dfrac{16}{25{,}000}$

The Ritter Formula

The Ritter formula $\dfrac{P_s}{A} = \dfrac{S_s}{1 + C_1\left(\dfrac{L}{r_g}\right)^2}$ is identical with Rankine's formula with the exception of C_1, which is theoretic and equal to $\dfrac{S_E}{C\pi^2E}$. The values of C are as follows:

Restrained	4
Restrained and hinged........	2.05
Hinged	1
Restrained and free..........	0.25

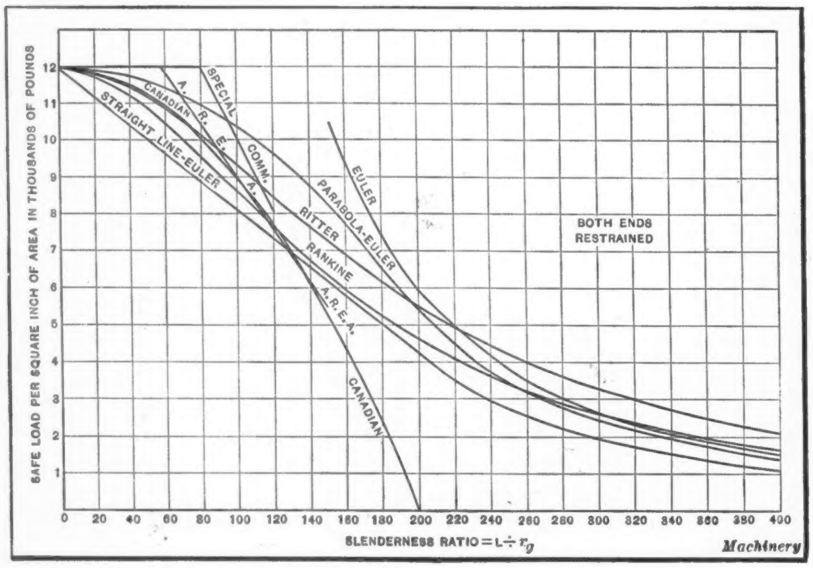


Fig. 1. Graph of Formulas for Columns when Both Ends are Fixed

When $S_E = 35{,}000$ the values of C_1 are:

Restrained	$\dfrac{1}{34{,}000}$
Restrained and hinged	$\dfrac{1.95}{34{,}000}$
Hinged	$\dfrac{4}{34{,}000}$

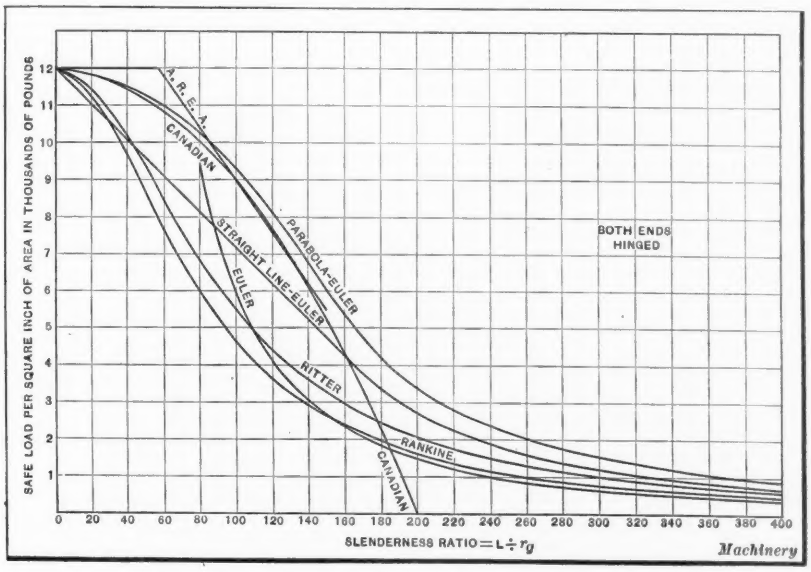


Fig. 3. Plotted Curves for Comparison of Column Formulas—Both Ends Hinged

Restrained and free	$\dfrac{16}{34{,}000}$

The Euler Formula

The Euler formula $\dfrac{P_u}{A} = \dfrac{C\pi^2 E}{\left(\dfrac{L}{r_g}\right)^2}$ for ultimate loads, may be transformed to

$$\frac{P_s}{A} = \frac{C}{5}\left(\frac{\pi^2 E}{\left(\dfrac{L}{r_g}\right)^2}\right)$$ for safe loads. Merriman's values of C in this case are:

Restrained	4
Restrained and hinged	2.05
Hinged	1
Restrained and free	0.25

The Parabola-Euler Formula

J. B. Johnson's parabola formula for ultimate loads is:

$$\frac{P_u}{A} = S_u - C_1\left(\frac{L}{r_g}\right)^2$$

He used $S_u = 42{,}000$ from which

$$\frac{P_s}{A} = \frac{S_u - C_1\left(\dfrac{L}{r_g}\right)^2}{3.5}$$

$$= 12{,}000 - \frac{C_1}{3.5}\left(\frac{L}{r_g}\right)^2 \text{ for safe loads.}$$

Dividing the constant in Euler's formula for ultimate loads by the same number (3.5) the formula becomes

$$\frac{P_s}{A} = \frac{C}{3.5}\left(\frac{\pi^2 E}{\left(\dfrac{L}{r_g}\right)^2}\right) \text{ for safe loads.}$$

Johnson's values of C are:

Restrained	$\dfrac{25}{\pi^2}$
Restrained and hinged	not given
Hinged	$\dfrac{16}{\pi^2}$
Restrained and free	not given

The value of C_1 and the value of $\dfrac{L}{r_g}$ at the point of tangency are given by

$$C_1 = \frac{S_u^2}{4C\pi^2 E} \quad\text{and}\quad \frac{L}{r_g} = \sqrt{\frac{2C\pi^2 E}{S_u}}$$

Values calculated for the diagrams are:

Restrained	$\dfrac{C_1}{3.5} = 0.168$	$\dfrac{L}{r_g} = 189$
Hinged	$\dfrac{C_1}{3.5} = 0.263$	$\dfrac{L}{r_g} = 151$

The value of E used by J. B. Johnson was 28,500,000.

The Straight-line-Euler Formula

T. H. Johnson's straight-line formula for ultimate loads is:

$$\frac{P_u}{A} = S_u - C_1\left(\frac{L}{r_g}\right)$$

He used $S_u = 52{,}500$ from which

$$\frac{P_s}{A} = \frac{S_u - C_1\left(\dfrac{L}{r_g}\right)}{4.375} = 12{,}000 - \frac{C_1}{4.375}\left(\frac{L}{r_g}\right)$$

for safe loads.

Dividing the constant in Euler's formula by the same number (4.375) the formula becomes

$$\frac{P_s}{A} = \frac{C}{4.375}\left(\frac{\pi^2 E}{\left(\dfrac{L}{r_g}\right)^2}\right) \text{ for safe loads.}$$

Johnson's values of C are:

Restrained	$\dfrac{25}{\pi^2}$
Restrained and hinged	not given
Hinged	$\dfrac{16}{\pi^2}$
Restrained and free	not given

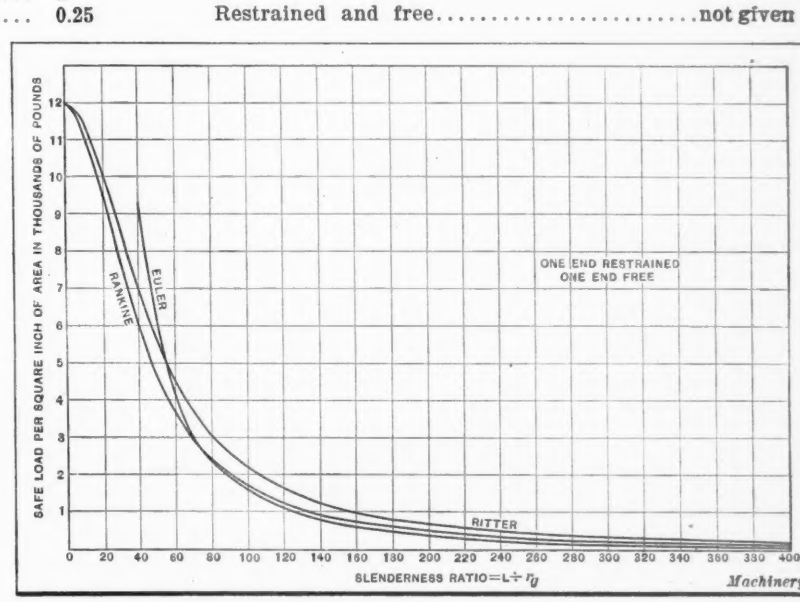


Fig. 4. Column Formulas graphically compared when One End is Fixed and One End Free

The value of C_1, and the value of $\frac{L}{r_g}$ at the point of tangency are given by

$$C_1 = \frac{2}{3} S_u \sqrt{\frac{S_u}{3C\pi^2 E}} \quad \text{and} \quad \frac{L}{r_g} = \sqrt{\frac{3C\pi^2 E}{S_u}}$$

The expression for C_1 is for any point, not only the point of tangency.

The values calculated for the diagrams are

$$\text{Restrained} \quad \frac{C_1}{4.375} = 38.649 \qquad \frac{L}{r_g} = 207$$

$$\text{Hinged} \quad \frac{C_1}{4.375} = 48.305 \qquad \frac{L}{r_g} = 166$$

The values of C_1 and $\frac{L}{r_g}$ given by T. H. Johnson indicate that he used $E = 27{,}000{,}000$, approximately.

American Railway Engineering Association Formula

The A. R. E. A. formula $\frac{P_s}{A} = S_s - C\left(\frac{L}{r_g}\right)$ is often used for both restrained and hinged ends when $S_s = 16{,}000$ and $C = 70$. The curve is ordinarily truncated at $\frac{P_s}{A} = 14{,}000$, but in the diagrams it is truncated at $\frac{P_s}{A} = 12{,}000$. No provision is made for different end conditions, and the graphs in Figs. 1, 2, and 3 are identical.

Special Committee of the American Society of Civil Engineers

The formula adopted by the Special Committee of the American Society of Civil Engineers $\frac{P_s}{A} = S_s - C\left(\frac{L}{r_g}\right)$ applies only to restrained ends and values of $\frac{L}{r_g}$ not greater than 120. The values of S_s and C are 20,000 and 100, respectively, and the curve is truncated at $\frac{P_s}{A} = 12{,}000$.

Engineering Institute of Canada

The formula adopted by the Engineering Institute of Canada $\frac{P_s}{A} = 12{,}000 - 0.3\left(\frac{L}{r_g}\right)^2$ is primarily for use in bridge design, and was derived mainly from the record of the tests made by the Special Committee of the American Society of Civil Engineers. The graphs in Figs. 1, 2 and 3 are identical.

Remarks

In preparing the curves, the variables employed were the slenderness ratio $\frac{L}{r_g}$ and the safe load per square inch of area $\frac{P_s}{A}$. The designation "allowable unit stress" is sometimes given to $\frac{P_s}{A}$, although the former is a constant and the latter a variable. The fact that limiting the working stress to 12,000 pounds also limits the safe load per square inch of area to 12,000 pounds is explained by the equality of S_s and $\frac{P_s}{A}$ when $\frac{L}{r_g} = 0$.

The value of $\frac{L}{r_g}$ at the point of tangency in the Parabola-Euler and Straight-line-Euler formulas is the same for graphs representing ultimate and safe loads.

It is often stated that Rankine's formula is not applicable to high values of $\frac{L}{r_g}$, and Euler's formula is recommended. An examination of the curves, however, does not reveal an appreciable discrepancy between them.

In investigations to determine the actual stresses resulting from a combination of compressive and other forces, it is essential that the actual stress due to each of the forces can be calculated. Of the formulas discussed herein only those of Rankine and Ritter are suitable for calculating the actual unit stress due to a given load and one or the other must be used in combined stress calculations when one of the stresses is compression. In a previous article the writer used Rankine's formula in discussing combined torsion and compression. Rankine's formula covers all types of ends, and it is quite generally conceded that no formula agrees more closely with the results of tests.

The diagrams were prepared primarily for the purpose of comparison, but their usefulness may be extended to problems of design and investigation. A table of coefficients is given below for working stresses greater than 12,000 pounds. The coefficients should not be applied to the A.R.E.A. and Special Committee formulas. The former was truncated at $\frac{P_s}{A} = 12{,}000$, as previously stated, and higher working stresses may be provided for when $\frac{L}{r_g}$ is less than 57.14 by disregarding the horizontal portion of the graph. This procedure in the case of the Special Committee formula would lead to very high unit stresses for low values of $\frac{L}{r_g}$, and moreover the propriety of any change whatever would be doubtful in view of the committee's recommendations. Likewise the Canadian formula does not contemplate working stresses greater than 12,000 pounds per square inch.

The Rankine and Ritter formulas may be used with any desired working stress, and the Euler, J. B. Johnson and T. H. Johnson formulas are in terms of ultimate loads; hence, the working stress depends upon the factor of safety. The coefficients may be applied to these five formulas.

COEFFICIENTS FOR VARIOUS WORKING STRESSES

Working Unit Stress, Pounds	13,000	14,000	15,000	16,000	17,000	18,000
Coefficient	1.08	1.17	1.25	1.33	1.42	1.50

Machinery

Example 1—The diameter D of a round steel column is 3 inches; the unsupported length is 10 feet, and one end is restrained and the other hinged. What would be the maximum safe load on the column using Rankine's formula with a working stress of 12,000 pounds per square inch?

Expressing the length in inches

$$\frac{L}{r_g} = \frac{10 \times 12}{\frac{D}{4}} = \frac{10 \times 12 \times 4}{3} = 160$$

Referring to Fig. 2, the safe load per square inch $\frac{P_s}{A}$ is 4000 when $\frac{L}{r_g} = 160$. The area of a 3-inch circle is 7.07 square inches, and the total safe load on the column is $7.07 \times 4000 = 28{,}280$ pounds.

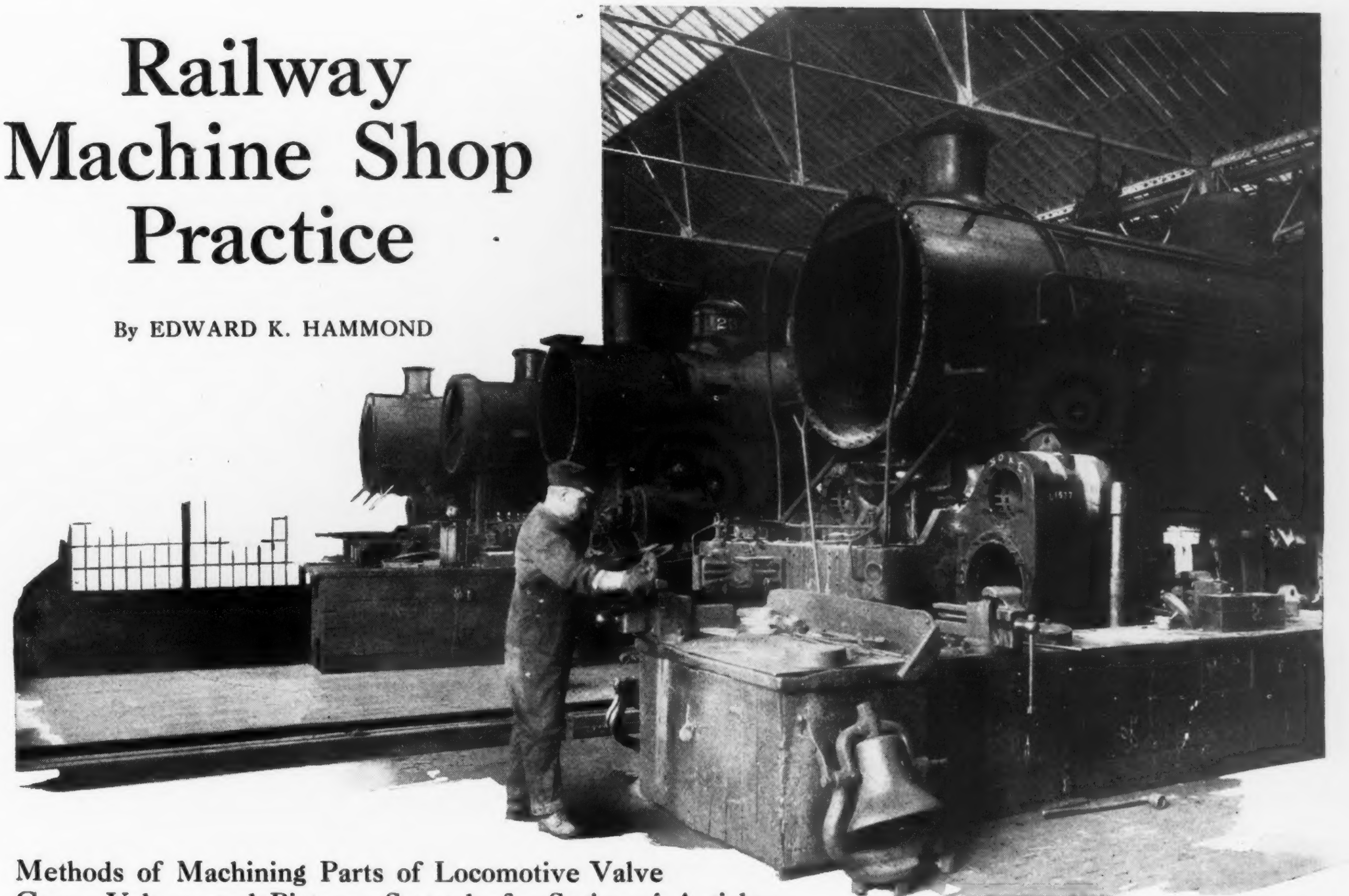
Example 2—What would be the total safe load on the column in the preceding example for a working stress of 16,000 pounds per square inch?

Using the table of coefficients

$$1.33 \times 28{,}280 = 37{,}610 \text{ pounds.}$$

Railway Machine Shop Practice

By EDWARD K. HAMMOND



Methods of Machining Parts of Locomotive Valve Gears, Valves, and Pistons—Second of a Series of Articles

ON locomotives which are equipped with the Stephenson type of valve gear, the admission of steam to the engine cylinders is controlled by eccentrics which are mounted on the driving axle at points just inside the journals. Fig. 1 illustrates a heavy-duty lathe built in the Pond Works of the Niles-Bement-Pond Co., at Plainfield, N. J., which has been especially equipped for turning the outside diameter of six Stephenson valve gear eccentrics at one time. Obviously this is quite a simple operation in so far as the actual turning is concerned. Before the pieces are set up in the lathe, they are bored, keyseated, and faced on the hubs so that these finished surfaces may be utilized in setting up the work.

Secured to the lathe faceplate, it will be seen that there is a mandrel *A* of such size that it will just enter the bore of the eccentrics. This mandrel is furnished with a flange *B* by means of which it is secured to the lathe faceplate with bolts and straps; and extending from the center of the opposite side of the flange there is a turned pilot that enters a hole carefully bored in the faceplate at a distance from the center of rotation exactly equal to one-half the throw of the eccentrics to be turned. At the right-hand end, it will be seen that the tail-center enters a hole located in the mandrel at the center of rotation. Location of the work is accomplished by means of a key on the mandrel that enters the finished keyway in the eccentric. The actual work of turning is accomplished in accordance with standard lathe practice. This illustration and the two following ones, refer to the practice of the Chicago & Northwestern Railway Co.

When an engine comes to a railroad machine shop to be overhauled for the making of repairs, it is often found that there are some parts which must be replaced. As the manufacture of locomotives has not been reduced to a quantity production basis, it is evident that a railroad might be able to handle work of this kind more economically in its own shops than by sending orders for replacement parts to the builder of the locomotive. Therefore, this procedure is followed in many instances, and this article describes methods used in machining valve gears and piston-rings in railway repair shops.

A practice was formerly made at the shops of the railroad mentioned, of facing the yoke bosses of the Baker valve gear eccentric rod on a slotter. A good job could be obtained in this way, but too much time was required, and a substantial economy has since been effected through the substitution of a method of milling these parts, as shown in Fig. 2. The work is handled on a milling machine built by the R. K. LeBlond Machine Tool Co. of Cincinnati, Ohio, which is equipped with a double-sided inserted-tooth milling cutter. Attention is called to the fact that in addition to the performance of the operation which is here illustrated, this milling machine equipment is employed for handling a variety of other jobs which are of the same general type as that shown.

Milling the Yoke Bosses on Baker Valve Gear Eccentric Rods

Secured to the table of the milling machine it will be seen that there are two short pieces of I-beam *A*, the flanges of which are drilled at the bottom to provide for bolting them down to the table, and at the top to receive bolts which are used with U-straps *B* to clamp the work to the I-beam supports. As the forging to be milled is made from a tough grade of steel, it is desirable to provide for the efficient cooling and lubrication of the cutter, and this is accomplished by placing a pan *C* filled with mineral lard oil under the cutter, so that the teeth are immersed as the cutter rotates. In setting up this job, the valve gear eccentric rod is laid across the tops of the I-beams and lined up with the line of travel of the milling machine table. Then it is merely necessary to feed the

work up to the cutter four successive times to provide for facing the four surfaces of the yoke bearing bosses. If this machine were used continuously for the performance of a specified manufacturing operation, it is obvious that a gang of cutters could be utilized to simultaneously finish all four surfaces, but as previously mentioned the same equipment is used for various milling operations, and so the yokes are not straddle-milled.

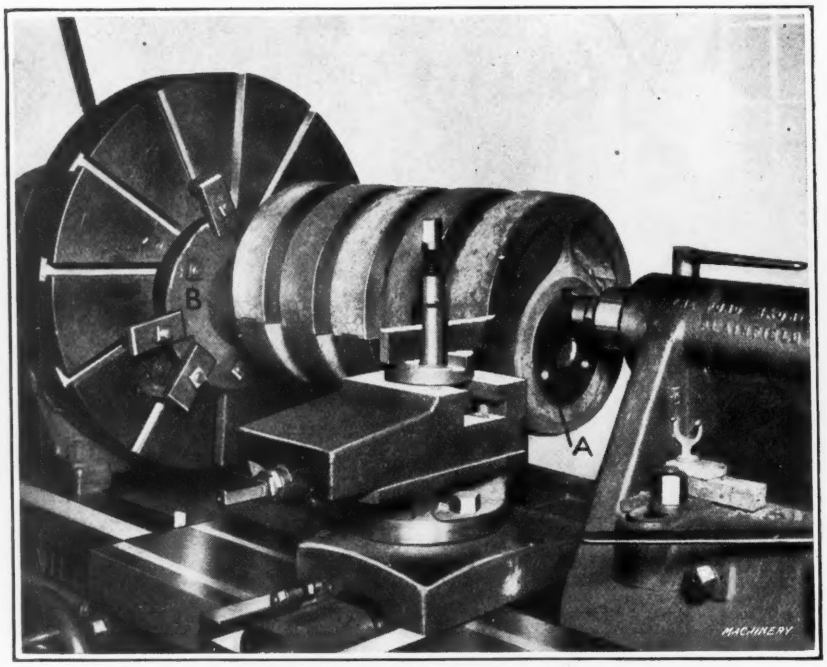


Fig. 1. Lathe equipped with a Special Work-holding Mandrel for carrying Six Stephenson Eccentrics

Boring and Turning Operations on Reverse Yoke for Baker Valve Gear

In machining the reverse yoke of the Baker valve gear, it is necessary to turn two trunnions *A*, Fig. 3, and to face the surfaces at the base of these trunnions; also, it is required to bore two bearing holes at *B*. To fulfill requirements, the two trunnions and the two bearings must be held in accurate alignment with each other, and the center lines of each must also be parallel and exactly spaced. This job is handled on a vertical boring machine built by the Gisholt Machine Co., Madison, Wis., which is equipped as shown. It will be seen that the fixture *C* is made in the form of an angle-plate with bolts set in the vertical leg, against which the work is clamped. No machining has been done on the work before it comes to this boring machine, and the first step is to strap the casting against the vertical plate of the fixture, and bore a hole in one of the bearings *B*. After this has been done, a pilot of exactly the required size to fit the finish-bored bearing hole, is set up on the base of the fixture, this pilot being located on the center of rotation of the table by means of a stem that fits a hole in the fixture. For boring the hole in the second bearing *B*, the work is located by the pilot entering the previously bored bearing hole; and it is then strapped against the vertical plate of the fixture. Held in this manner the boring operation in the second bearing can be performed with the assurance that the two bearings will accurately align.

It is necessary to reset the work for turning the first trunnion *A*, and the yoke is located during this operation by means of pilot *D*, over which the work is dropped to allow the pilot to enter one of the finish-bored bearings *B*. There are two of these pilots, one at each end of the fixture, and it will be evident that the work is shown set up with the pilot at the right-hand end of the fixture in position in the bearing. The method of strapping the work back against the vertical plate of the fixture and down on the pilot is made fairly evident from the illustration, but it may be mentioned in this connection that for use with each pilot there is a bolt and slotted strap that provide for holding the work down, the action of this holding medium being supplemented by a large clamp secured directly to the table of the machine. The illustration shows the work of turning the second trunnion, and it will be seen that the tool, in the position illustrated, has finished its downward feed and is engaged in facing the horizontal surface which surrounds the trunnion.

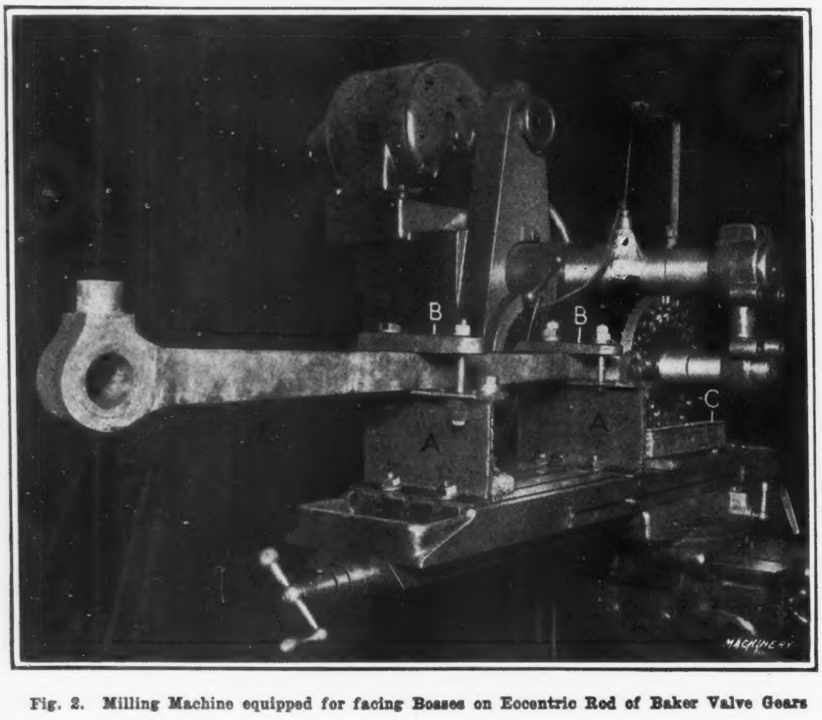


Fig. 2. Milling Machine equipped for facing Bosses on Eccentric Rod of Baker Valve Gears

Expanding Chuck for Turning Piston Valve Rings

For use in turning and facing operations on piston valve rings in the Silvis shops of the Chicago, Rock Island & Pacific Railway, an interesting special chuck has been developed to meet the requirements of the job. Reference to Fig. 4 will show that the piston-ring *A* on which the turning and facing operations are to be performed is placed over a chucking ring *B*, which is slotted radially at a number of places, these slots starting alternately from the inner and outer surfaces of the chucking ring and running almost through it. The inside of ring *B* is engaged by pins *C* which, when operated, apply sufficient pressure to expand the outside diameter of the slotted ring *B*. This is accomplished by means of a screw *D* which actuates a tapered plug against which the inner ends of pins *C* bear. At the time the piston-rings arrive at this lathe, they have been bored, so that the finished bore may be utilized as a locating surface. Very little time is required to set the work up on a chuck of this kind. In so far as the turning and facing operations are concerned, there is nothing of especial interest, but it may be mentioned that the rings are required to pass inspection with "Go" and "Not Go" gages for both width and thickness.

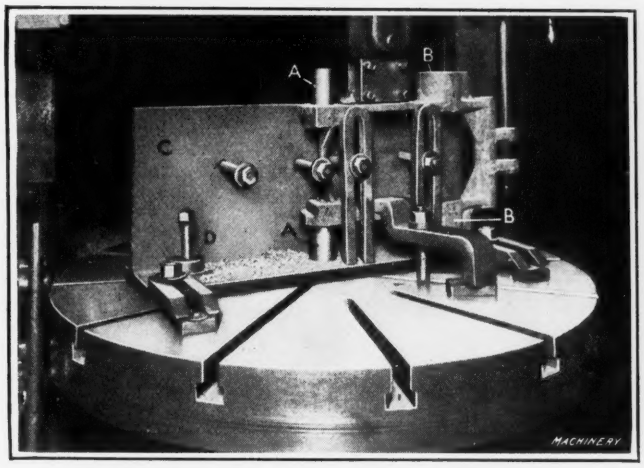


Fig. 3. Vertical Boring Machine and Fixture for holding Reverse Yoke of Baker Valve Gear while boring and turning

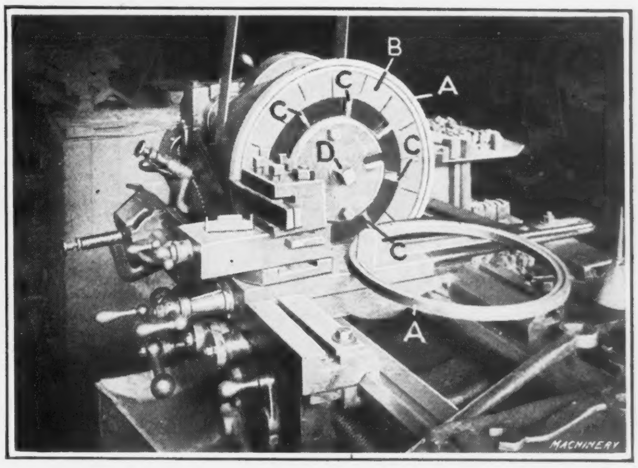


Fig. 4. Special Expanding Chuck for holding Piston-rings during the Performance of Turning and Facing Operations

Quick Method of Cutting Piston-rings

After a piston-ring has been machined, it must be severed and enough metal removed to allow the ring to be compressed sufficiently to enter the cylinder. Through the tendency of the compressed ring to return to normal shape, there is obtained an effective seal to prevent leakage between the piston and the cylinder. In Fig. 5 there is illustrated a simple machine developed in the Silvis shops of the Chicago, Rock Island & Pacific Railway, which provides an economical method of handling this operation. The machine consists of a pedestal, at the top of which is supported a hardened steel anvil *A* on which the ring rests while being cut. Above the ring there is a second anvil *B* that is carried by a spring-supported block so that it is normally held with sufficient space between the upper and lower anvils for the admission of a piston-ring *C*. The cut is made by simply striking the top of head *D* with a sledge hammer, and after one cut has been made the ring is moved slightly, as shown, ready for making the second cut to remove the necessary amount of metal. Formerly, a practice was made of handling this job on a power hacksaw, but much more time was required to do the work in this way and although a somewhat smoother cut is produced, this is really of no especial advantage because the shearing machine now employed for performing this operation fulfills all requirements.

Cutting Piston-rings on the Slotter

Fig. 6 shows another method of removing a segment of metal from a piston-ring, the job shown in this illustration being handled on a slotting machine built by the Newton Machine Tool Works, Inc., of Philadelphia, Pa. It will be seen that where this method is employed, a stack of fifteen rings is placed on the slotter table and that these rings are held on parallels *A* so that they are raised sufficiently to afford clearance for the tool beneath the lowest ring. The rings are held down by means of the familiar arrangement of straps and clamping bolts, care being taken to place one clamp on each side of the segment which is to be removed. After the slotting tool has taken one cut on fifteen rings, the operation is repeated at the section of ring near the second clamp, to permit removing the segment of metal from each ring.

Turning, Boring, and Facing Piston-rings

In the manufacture of piston-rings for use in air pumps, the Chicago & Northwestern Railway Co., has adopted the

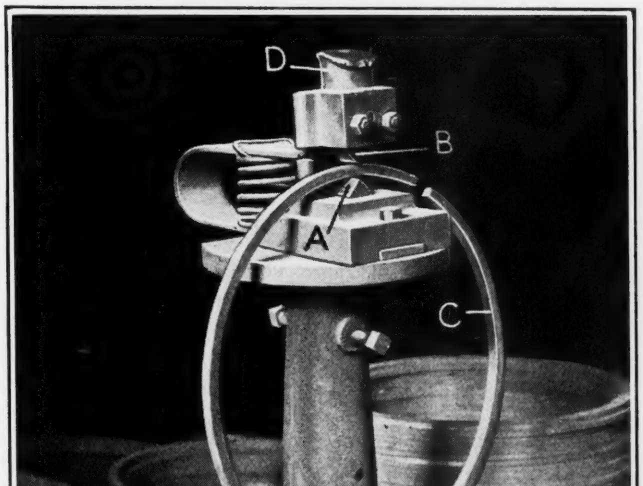


Fig. 5. Special Machine developed to provide a Rapid Means of cutting Segment from Piston-rings

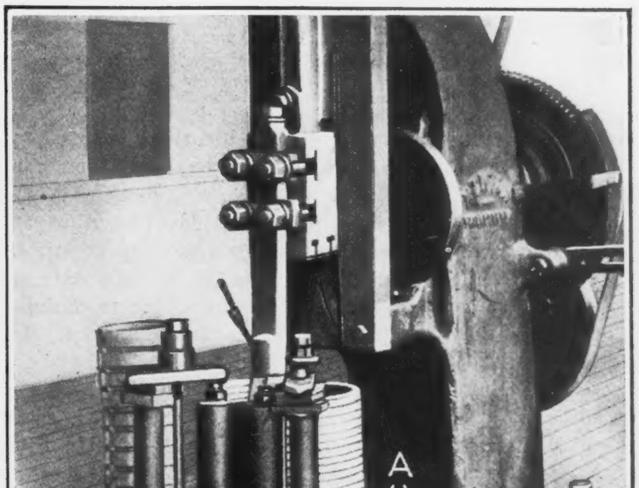


Fig. 6. Slotter equipped for splitting Fifteen Piston-rings at a Single Setting

following procedure. To expedite the performance of turning and boring operations, both castings are delivered to the lathe on which this work is handled. Reference to Fig. 7, which shows the work set up for the preliminary operation, will make it apparent that there are lugs provided on the pot casting with bolt holes to facilitate attaching to the faceplate. On the tail-spindle there is a center *A* of sufficient size to enter the open end of the pot casting and afford the necessary outboard support. Three successive operations are required to complete the preliminary machine work: First, the outside of the pot casting is rough- and finish-turned to the required diameter, after which the casting is slotted with multiple parting tools, carried in a block of the type shown at *B*, this tool-block having the parting tools properly spaced for cutting the grooves which establish the unfinished width of the piston-rings. After this operation has been completed, the tail-center *A* is withdrawn and a boring tool is utilized to machine the inside of the casting to the required diameter. The grooves cut in the previous operation were sunk to such a depth that as the boring tool removes the surplus metal by means of which the casting is held together, the rings drop off successively while the boring tool is progressing through the work.

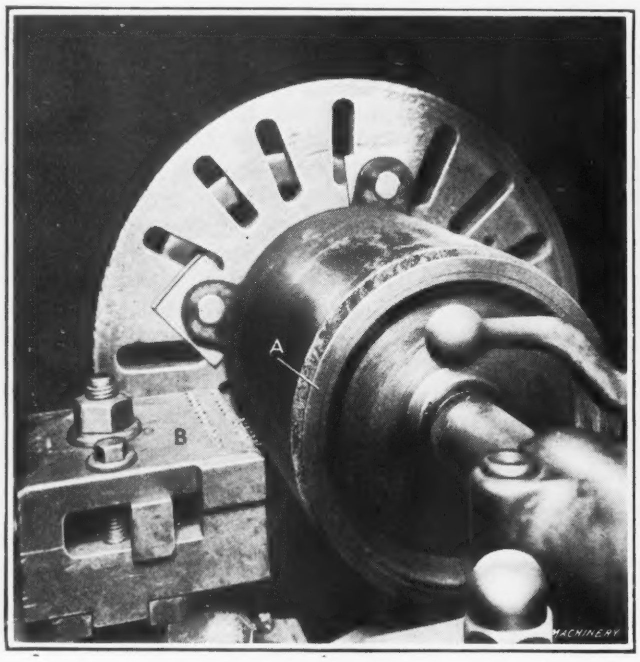


Fig. 7. Method of chucking a Pot Casting for turning Air Pump Piston-rings, and Multiple Parting Tool used

The rings produced by the method just described still have to be faced on the sides to reduce them to exactly the required width and to give the desired finish. For this purpose the work is transferred to a lathe which is equipped, as shown in Fig. 8, with a special magnetic chuck *A*. Magnetic force is depended upon to hold the work in place on the chuck, but to facilitate the labor of centering each ring in anticipation of the facing operation, there is a set of mechanically operated jaws *B* that engage the inside of the ring. At their inner ends these jaws engage a taper plug which is pushed inward by tightening a knurled nut *C*, and this causes the jaws to be expanded sufficiently to bring the ring approximately concentric with the center of the chuck. The facing operation is a simple lathe operation, but it may be mentioned that after one side of a ring has been rough- and finish-faced, it is turned over and relocated on the magnetic chuck from this finished surface, so that both sides are finished exactly parallel. Each ring is required to test up properly in a "Go" and "Not Go" gage *D*, in which two piston-rings *E* are shown. One of these rings is under size as regards width; otherwise it would not enter the "Not Go" opening of the gage.

MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The 1921 spring meeting of the American Society of Mechanical Engineers will have many noteworthy events. It will open at McCook Field, Dayton, Ohio, on May 21, where the Society of Automotive Engineers and the Aeronautic Section of the American Society of Mechanical Engineers will meet jointly to inspect the field. Following the main meeting at Chicago an excursion will be made to Rock Island Arsenal with the Ordnance Section.

Friday morning will be devoted to a trip through the arsenal, with a technical meeting in the afternoon. The Ordnance Department is cooperating fully in the Rock Island program. The local Tri-Cities Section of the society will have charge of the arrangements during the sojourn at the arsenal.

The meeting proper will be held at Chicago, May 23 to 26. The plans for the sessions, under the auspices of the various professional sections, are well under way and a program of value is assured. The Forest Products group promises an interesting program of miscellaneous papers on the subjects in their field which were not covered at the annual meeting in New York. The Fuel Section will consider as its main subject the burning of mid-western fuels. An excursion is planned to Milwaukee to visit the new installation of the powdered-coal plant of the Milwaukee Electric Railway & Light Co. The Machine Shop Section is devoting its program to the consideration of the effect of the automotive industry upon machine tool design and machine shop practice. Papers are in process of preparation to cover this subject.

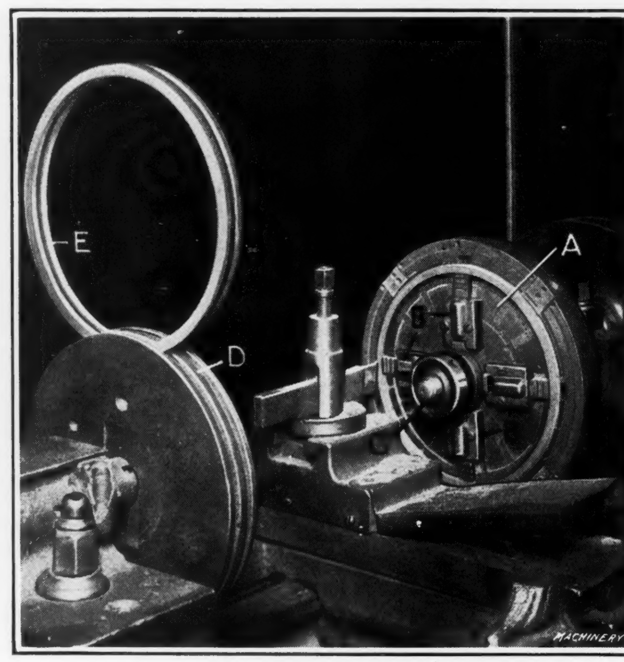
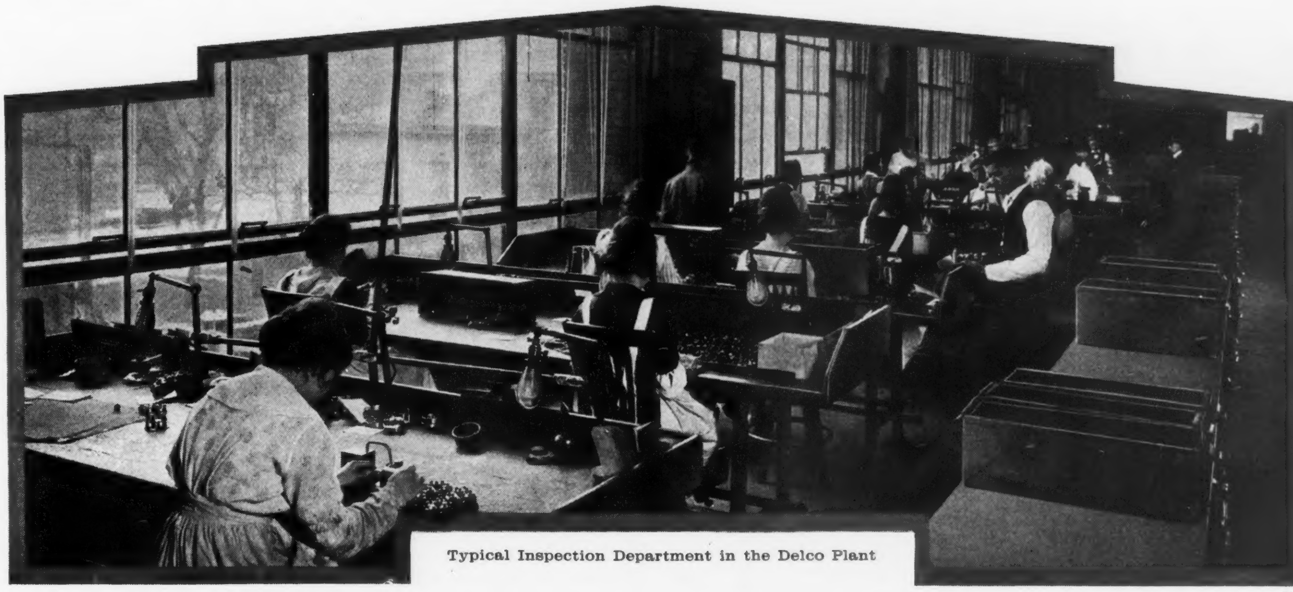


Fig. 8. Special Magnetic Chuck used in Facing Operations on Rings cut from Pot Casting shown in Fig. 7

The Management Section will have a program made up of three papers and a report of the joint committee on Management Terminology. The Materials Handling Section will devote its time to the treatment of the problem of design and construction of machinery for road building. Four papers are planned which will treat the problem from the point of view of the contractor, the road builder and possible future development of mechanical equipment in road building. Instead of excursions a number of very interesting films are being arranged for. The Power Section has made tentative plans to discuss power resources and development in the Middle West. The subject to be discussed by the Railroad Session will be the design of large freight locomotives.



Typical Inspection Department in the Delco Plant

Principles of Inspection

A Detailed Review of the Principles upon which Rational Inspection Methods are Based, with Special Application to Interchangeable Manufacture*

By LOUIS RUTHENBURG, Superintendent, and R. A. CRIST, Assistant to the Superintendent of the Dayton Engineering Laboratories Co., Dayton, Ohio

INSPECTION should be considered in a broader sense than is ordinarily the case. Generally, inspection is thought of as the mere verification of the dimensions of parts. This is too narrow a view of the scope of this branch of manufacture. The inspection department is that part of a manufacturing organization which is charged with the full responsibility for safeguarding the quality of the product. The function of the inspection department in manufacture may be likened to that of the judiciary system in civil life, namely, to interpret and enforce the laws. In the case of the inspection department the laws which it must interpret and enforce are those governing the quality of the product. The judiciary could not function without laws upon which to base judgment; neither could the inspection department function without laws upon which to base its operations and govern its decisions. The laws that are interpreted and enforced by the inspection department are the specifications originated and approved by the engineering department.

The Scope of Inspection

Inspection as applied in large modern manufacturing plants covers a wide range of activities. It includes the inspection of the materials received from outside manufacturers either in the form of raw materials or finished products. It further covers the inspection of the parts manufactured in the plant, and the inspection and testing of the assembled and completed machines or devices manufactured. It also includes the verification and testing of gages, and inspection and testing of all special tools, jigs, and fixtures to be used by the manufacturing departments, as well as the inspection of all machine tools and devices bought from outside manufacturers for use in the plant. Briefly, therefore, it covers the inspection and testing of everything that enters the plant, as well as of everything that leaves the plant. It assures that the manufacturing departments are provided with the proper materials, tools and machines with which to work, and it is responsible for the quality of the product.

The present article on the principles of inspection methods is based on a paper prepared for a training course for executives by the executive training course committee of the Dayton Engineering Laboratories Co. This committee consists of Louis Ruthenburg, superintendent, R. A. Crist, assistant to the superintendent, W. E. Baker, employment manager, and O. T. Kreusser, educational head, working in cooperation with other executives of the Delco organization. The principles laid down, therefore, constitute the authoritative record of the best practice in inspection, as the highly developed and systematic methods of the Delco organization are well known throughout the whole engineering world.

Inspection Specifications for Materials

The laws or specifications that govern the work of the inspector cover the whole range of inspection as outlined in the previous paragraph. Dealing first with the inspection of materials, it will be found that a large part of the work of the inspection department consists in comparing materials with established specifications, and in passing or rejecting those that conform or fail to conform with these specifications. The specifications should cover any property of the material that will affect its ability to give the proper service for which it is intended.

The more usual specifications covering materials used in the manufacture of mechanical or electrical machines and devices are as follows: (1) Dimensional specifications; (2) chemical specifications; (3) physical specifications; (4) electrical specifications; (5) treatment and finish specifications; and (6) performance specifications. In preparing specifications, it must be remembered that exact duplication is not possible in any mechanical process. Two pieces of steel cannot be finished to exactly the same dimensions. One of them may vary from the other by only an infinitesimal part of an inch, but they cannot be identical. As a result of the recognition of this

fact, specifications must provide limits—maximum and minimum limits—and the difference between the limits is known as tolerance.

In the same way as limits are provided for dimensions, so chemical limits and tolerances are specified for the composition of material. Instead of specifying 0.20 per cent carbon steel, the specifications would call for a carbon content within the limits of 0.15 and 0.25 per cent carbon. This provides for a tolerance of 0.10 per cent, or "ten points."

In physical specifications, tolerances and limits are seldom given, because they are of no importance. Specifications of this kind may be called "single-limit" specifications. For example, the strength of a certain class of steel may be specified by saying that the elastic limit must be 90,000 pounds per square inch. This is the minimum limit. The maximum limit is of no importance. It makes no difference how much stronger the steel is, so long as the minimum limit is equalled or exceeded.

Specifications for the Work in the Manufacturing Departments

The modern tendency is to place on the engineer or designer the full responsibility for definite specifications. Instead of using such expressions as "running fit," "force fit," "screw stock," "cold-drawn steel," "carburized," "oil-hardened," "file-hard," etc., modern manufacturing practice requires that the engineering department shall provide specifications giving definite limits or directions.

This does not mean that proper specifications can be established arbitrarily from the limited point of view obtainable from the drafting table or the laboratory. On the contrary, satisfactory specifications are only obtainable through the closest cooperation between all the departments of an organization. Correct specifications can best be provided as follows:

Satisfactory limits and specifications for manufactured products cannot be established arbitrarily from the limited point of view obtainable from the engineer's desk, the drafting table, or the laboratory. On the contrary, satisfactory specifications are only obtainable through the closest cooperation between all the departments of an organization. The records of the product in service must be studied; the customer's requirements must be considered; and existing standards must be taken into account.

First of all, the records of the product in service must be studied. If the machine or apparatus built, or any parts of it, are giving trouble, the reports of these troubles should be closely studied by the engineering department with a view to so changing the specifications as to avoid similar difficulties in the future. If new machines or apparatus are being designed, the service records of previously designed similar apparatus must be carefully studied before specifications for the new apparatus are adopted.

Next in importance to service records are the customer's requirements. These requirements are, of course, based primarily upon his own service records, but often the customer has some individual requirements which must be carefully considered in order that the specifications established may properly meet his needs.

The third thing to be considered in establishing specifications is existing standards. There are certain analyses of steel that are generally accepted as standard among steel makers. It would be short-sighted and expensive to specify a steel differing but slightly from an accepted standard, if no benefit resulted from the use of the steel with the odd specifications. If screw threads of certain dimensions are an accepted standard among automobile makers, for example, it would be unwise for makers of automobile accessories to specify other thread dimensions, except under very unusual conditions that might justify the use of a thread not accepted as standard.

Shop standards must also be given careful consideration, as well as the limits imposed upon the engineer by the mechanical processes and equipment by means of which the work is to be done. In specifications covering shafts and holes, for example, it is good practice to provide a larger tolerance for the hole than for the shaft, because it is less expensive to maintain close limits on external dimensions than on internal dimensions. Furthermore, dimensions should be so given, whenever possible, that tools of accepted standard may be utilized, and treatment and finish specifications should only be adopted after a careful study of existing shop practice and the available equipment.

A careful study of the specifications is a very important part of the whole inspection system. Just as unreasonable laws can be enforced only with difficulty or not at all, so unreasonable specifications cannot be lived up to except at great expense and loss of efficiency. Specifications and inspection are tied together as closely as the law in civil life and its enforcement. It is impossible to arrive at a correct understanding of the functions of the inspection system without first having a clear understanding of specifications and the methods by which they are decided upon.

Interchangeable Manufacturing and Inspection

The most highly developed inspection systems are those found in plants having a highly developed system of interchangeable manufacture. In fact, interchangeable manufacture may be said to be the basis of modern inspection specifications and methods. The subject of interchangeable manufacture was dealt with completely in the series of articles by Major Earle Buckingham, published in MACHINERY during the last two years, and it is therefore unnecessary at this time to treat in detail of the advantages of interchangeable manufacturing methods. It may be enough merely to summarize these advantages by saying that the main object of interchangeable manufacturing is to reduce costs.

One of the main reasons that costs can be reduced is that where the interchangeable system is properly applied, a less skilled grade of labor can be employed. A skilled mechanic is required to make a number of parts alike within the required limits without a gaging system; but a semi-skilled mechanic can make a much larger number of parts in the same time alike within the required limits when the proper tool equipment, and gaging and inspection methods are used. Furthermore, when the parts are made interchangeable, a great deal is saved in the assembling department. Thus the advantage gained by interchangeable manufacture is not only that all parts are made alike, but that production costs are greatly reduced.

The Limit System

The limit system, which forms the basis of interchangeable manufacturing, is applied in a number of ways in manufacturing plants. In some cases the system, as generally understood, is only partially applied. The importance of and the principles involved in the limit system have also been covered in the articles by Major Buckingham on interchangeable manufacturing, previously referred to. It may be sufficient to summarize the advantages gained by its use. It makes an interchangeable product possible, eliminates the necessity of depending upon the judgment of the workmen and the inspector, and reduces the amount of spoiled work to a minimum.

In some cases the initial cost of installing a limit system is heavy, but when it is considered that a properly organized limit system greatly reduces inspection and manufacturing costs, it will be found that the advantages to be gained will generally more than offset the initial expense. The experience of every large plant working on the interchangeable basis verifies this.

Setting Manufacturing Limits

The setting of limits on work which is to be made on the interchangeable basis is one of the most vital parts of the work of a manufacturing organization; and upon the knowledge, care, and common sense used in doing this work may often depend the success or failure of the manufacturing enterprise. The practice of specifying proper limits saves much needless expense. Suppose a tool drawing specifies the length of a part in fractions of an inch, and does not give any limits. It may be that it would be of no practical importance if the part was one-sixty-fourth inch more or less than the size designated. Yet the toolmaker would be very likely to spend a considerable amount of time in making the part as nearly to the size specified as possible with ordinary machining means at his disposal, thereby greatly increasing the cost.

Both manufacturers and workmen frequently make use of the expressions, "exactly one inch," "right up to dimensions," "without any tolerance," etc. Such expressions indicate a lack of understanding of the conditions present in manufacturing. To a toolmaker such an expression may mean an accuracy within a tolerance of one ten-thousandth inch; to a machinist it may mean an accuracy within a thousandth inch; and to a woodworker it probably would mean an accuracy to a tolerance of one-sixteenth inch. No matter how skillful the workman nor how accurate the machines and measuring instruments at his disposal, the work produced must always vary to some extent from the established dimensions. Hence the necessity for establishing a limit system.

The object of the limit system is often misunderstood. Except in isolated cases, the limit system is not intended to attain the highest possible degree of accuracy, and the best limit system is not that which does attain this accuracy. The best limit system is that which insures that each part will be made as accurately as is required in order that it should give the kind of service expected from it. Too small tolerances are often wasteful and extravagant; too great tolerances may mean failure to provide a machine or device of the quality required. It is only by a close study of the hundred and one conditions that enter into the manufacture and the service of a given part that the best tolerances in any given instance can be determined upon, but when the tolerance has been established, whether it be a ten-thousandth or a sixteenth part of an inch, it should be maintained by the manufacturing and the inspection departments until changed conditions or a more complete study of the problem renders it advisable to make a revision.

A great many methods have been evolved for establishing a system of limits, but practically no two manufacturers use the same system for setting limits or give the same permissible amount of error in manufacture. No general rule can be laid down, as the tolerance depends entirely upon the character of the work and the conditions under which the parts are to operate. Set rules cannot be established. Judgment and experience may be said to be the only basis for the establishment of manufacturing limits. A review of the tolerances within which work may be kept when using different machining methods in regular manufacturing practice is given in the article "Developing a Gaging System," published in MACHINERY, October, 1918.

Organization and Functions of an Inspection Department

Successful organizations are usually shaped about the personalities involved, rather than built to conform with some ideal paper plan. For this reason it is impractical to lay down a definite rule as to the final responsibility for inspection in all organizations. It is fairly obvious, however, that such final responsibility should rest with the person possessing, or who is in a position to obtain, the clearest conception of quality requirements as balanced against that which is commercially desirable or practicable. These qualifications are usually held by the man broadly responsible for the management of the business, and he should therefore be closely in touch with the inspection department.

Under such conditions it may be fairly stated that a chief inspector who is independent of the manufacturing departments and whose opinions of quality will not be influenced by a desire to obtain increased production, will naturally be able to maintain a higher standard of quality than would otherwise be the case. On the other hand, the inspection department must not become so technical and academic in its judgment that the product is needlessly rejected. The influence of the general manager will make itself felt in this direction.

While the inspection is a separate unit in the organization, it should be clearly understood that the work of the inspection department must at all times be in full harmony with the manufacturing work, and that there must be the fullest cooperation between the inspection and the manufacturing departments, so that all questions arising may be speedily disposed of and all controversy settled in a friendly and harmonious manner.

The methods of inspection must be decided upon and the scope of the inspection department's work must be worked out differently in different plants. In following articles to be published in MACHINERY the methods employed in the actual organization of the inspection department and in the carrying out of the duties of inspection at the Dayton Engineering Laboratories Co. will be dealt with in detail. These methods have been worked out over a considerable period of time, have been checked from time to time to conform with the requirements, and have been developed to a point where they meet the needs of this plant in an unusually satisfactory manner. The principles involved in these methods will doubtless be found applicable to a great number of plants manufacturing a variety of products in quantities.

A careful study of the specifications is one of the most important functions of the whole inspection system. Just as unreasonable laws can be enforced only with difficulty, or not at all, so unreasonable specifications cannot be lived up to except at great expense and loss of efficiency. Specifications and inspection are tied together as closely as the law of civil life and its enforcement. It is impossible to arrive at a correct understanding of the functions of inspection without first having a clear understanding of the method by which the specifications have been determined upon.

The Gaging System

Having determined upon the method of conducting the inspection during the manufacture, the next consideration is the gaging system, since the gaging system provides the means by which the requirements of the limit system are carried out. It is not necessary here to review the types and classifications of gages, as these have been thoroughly dealt with in past articles published in MACHINERY, in the October, November, and December, 1918, January and February, 1919, and July and August, 1920, numbers; the following books published by THE INDUSTRIAL PRESS also cover this subject: "Gages, Gaging and Inspection," by Douglas T. Hamilton; "Gage Design and Gage Making," by Erik Oberg and Franklin D. Jones; and a forthcoming book on "Principles of Interchangeable Manufacturing," by Earle Buckingham.

Special methods in the designing and use of gages and special gaging fixtures used by the Dayton Engineering Laboratories Co. will be described in articles to be published in coming numbers of MACHINERY. While, therefore, it is not necessary in this review of the principles of inspection to deal with the different classes of gages used, it is, how-

ever, of great importance to point out in detail the application of the gaging system and its relation to the inspection system.

Application of the Gaging System in Inspection

In the application of a practical gaging system as part of the inspection system of a modern manufacturing plant, certain considerations are fundamental. The basic requirements of modern manufacturing practice may be set forth in the form of a table. On the one hand, the fundamental ideals toward which the manufacturer may direct his efforts are indicated. On the other hand, we have the essential practical equipment with which he must be supplied, and the equally practical conditions under which the work must be conducted in order to attain approximately the ideals aimed at.

Things Desired	Means Required
1. Maintenance of limits	1A. Tools, jigs and fixtures of maintained accuracy under conditions of high-speed operation
2. Reduction of time factor	2A. Working gages of maintained accuracy under conditions of high-speed operation
	3A. Elimination of personal element in mechanical operations

It may be of interest to consider briefly the points indicated in the accompanying table. The maintenance of limits has already been considered in this article in connection with the setting of manufacturing limits for interchangeable parts.

The object of the limit system is often misunderstood. Except in a few isolated cases, the limit system is not intended for attaining the highest possible degree of accuracy, and the best limit system is not that which does attain this accuracy. On the other hand, the best system is that which insures that each part will be made only as accurately as is required to give the kind of service expected from it. Too small tolerances are wasteful and extravagant; but, on the other hand, too great tolerances may result in utter failure to provide a machine or device of the quality required.

Reduction of Time Factor

The subject of reducing the time factor is so comprehensive that every effort toward efficiency may be said to hinge upon it. Volumes have been written on this subject without accomplishing more than scratching the surface. To do more than mention its broader phases here would be impossible. Material, overhead, and labor are the three items of expense entering into every manufacturing operation. Of these items labor is the greatest, not only directly, but also indirectly, because of its control of the others. When we save labor we also save time, and it would be just as accurate to speak of time-saving devices as of labor-saving devices. When time is conserved, labor may accomplish more and greater things. What we really mean by a labor-saving device is not that it saves labor, but that it saves the time of labor, so that labor may be used for other purposes to best advantage.

Tools, Jigs, and Fixtures of Maintained Accuracy

A prominent manufacturer of special tools recently said: "I find it much easier to satisfy Brown's requirements than those of Smith." It happens that Brown is the maker of an unusually high-grade expensive automobile, while Smith builds cheap cars in great quantities. Hence, it seemed peculiar at first that it should be easier to satisfy the requirements of Brown. The explanation, however, was as follows: The manufacturer of the high-grade automobile takes a great deal of time to produce his car. In his plant they can give more attention to the tools, and they do not use them as severely; they do not wear away from the original dimensions as rapidly. The manufacturer building cheaper cars in large quantities has his whole plant keyed up to produce work at the greatest possible speed. The average tolerances in his manufacturing processes are fairly large, but these tolerances must be accurately maintained or the high speed of the assembly work would suffer. The tools wear away from the original dimensions much more rapidly because they are subjected to more severe usage; hence the original requirements in the making of jigs, tools, and fixtures of all classes for the cheaper car are by necessity more exacting than in the other case.

The idea brought out furnishes much food for thought. It seems at first to be a paradox that the cheapest products should be produced by the most expensive tools, but when carefully considered it will be found that where the profit margins are the closest, the manufacturing efficiency must reach the highest mark. The limits must be maintained; the time factor must be reduced; and the accuracy of the tools must therefore be maintained. Frequent inspection and repair of tools, jigs, and fixtures become necessary, and the time involved in these operations becomes a profitable investment.

Maintaining the Accuracy of the Working Gages

In the accompanying table it may be thought that the maintenance of the accuracy of working gages has been too strongly emphasized. It may also be thought that the working gages could be grouped with the tools. Here again we come back to our analogy between a manufacturing organization and civil life. Working gages may be regarded as bearing the same relation to tools, jigs, and fixtures that a police force bears to the commercial interests of a city. The gages are the veritable guardians of the peace in the factory. Just as long as the tendency to err keeps within the law, these safeguards may seem of little importance. They may even be scorned as representing a useless expense. But consider what happens in a factory equipped with unsatisfactory working gages when it encounters one of those unavoidable "crime waves" of defective workmanship. Just as soon as this happens, complaints from customers make it clear that a dangerous condition exists, and an effort is immediately made to organize an efficient system of gaging—to create a police force—equipped to prevent defective workmanship.

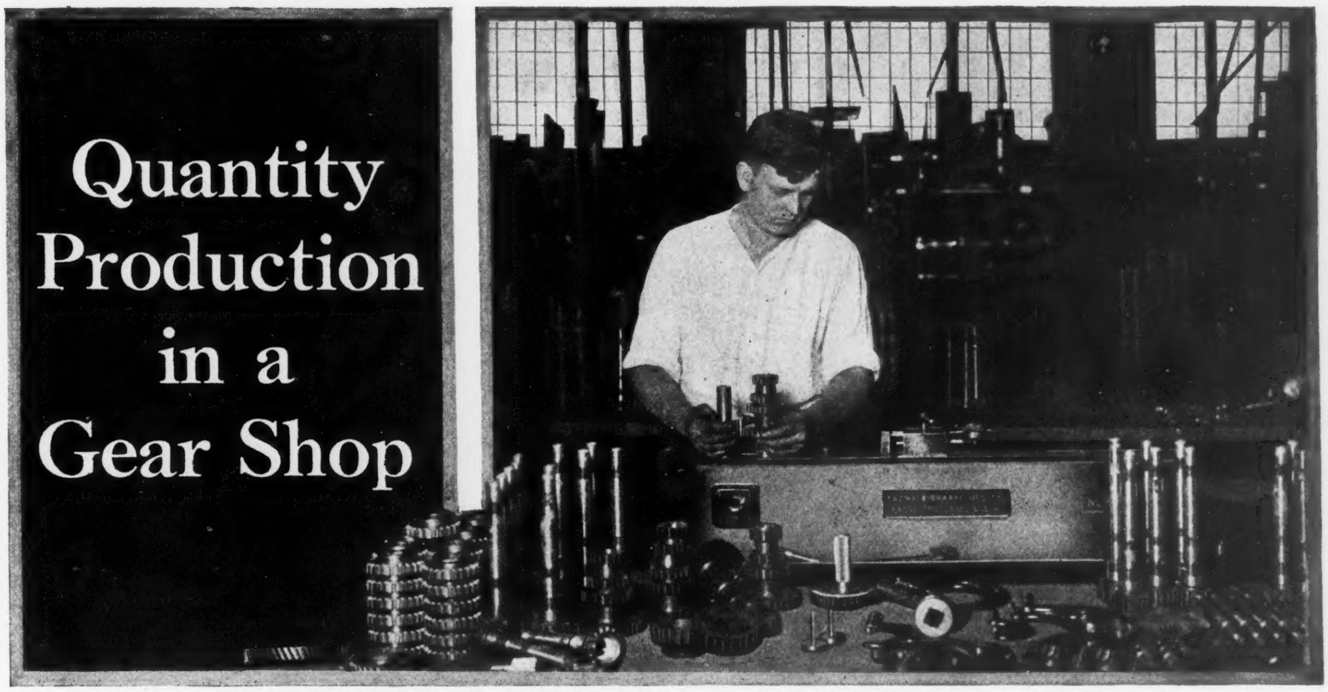
Too often in manufacturing plants, tools and gages are lumped together as one item, and because of the urgent need of starting production, the gages are neglected until a disregard of the working limits and the succeeding confusion and expense emphasize their necessity.

Elimination of Personal Element in Mechanical Operations

With a certain fixture an experienced operator produces parts within the prescribed limits. With the same tool an unskilled workman is unable to produce work that will pass inspection. This indicates that the fixture should be redesigned so that a less experienced workman may produce more parts with an equal degree of accuracy in the same length of time as the experienced operator. In this way the influence of the personal element has been reduced.

With a pair of micrometers a skillful inspector can gage parts accurately for diameter. With a limit snap gage an untrained girl more accurately inspects the same number of parts in less time, and the tendency toward errors has been minimized. The personal element has been eliminated.

In any industry a definite function of inspection is the matter of service to the manufacturing or producing departments. The inspection system should be a bulwark against the lowering of quality in order to obtain quantity, but due consideration must be given all factors involved, with the idea of rendering the greatest possible service to the factory in the production of quality apparatus.



Quantity Production in a Gear Shop

Practice of the Dittmer Gear & Mfg. Corporation, Lockport, N. Y., in the Manufacture of Gears for Tractors, Trucks, and Automobiles—Second of Two Articles

By FRED R. DANIELS

THE first installment of this article, published in the April number of MACHINERY, described the preliminary steps in preparing the stock for the machining operations, and dealt in detail with the machining operations previous to cutting the teeth of various types of automobile gears. The present installment will deal with the cutting of the teeth, the heat-treatment, the grinding operations, and the inspection.

Cutting the Teeth

After the roughing operations on the gears are completed, they are given a preliminary inspection and are then passed on to the gear-cutting department, where the teeth are roughed on Cincinnati hobbing machines and finished on Fellows gear shapers, a battery of which may be seen in Fig. 11. This statement is, of course, a general one, as it will be evident that for hobbing the teeth in gear *E*, for example, of the cluster gear shown in Fig. 8 in the first installment, sufficient clearance space is not available between gears *D* and *E* to permit the use of a hob, and in such a case both the roughing and finishing cuts are performed on a Fellows gear shaper. Fig. 11 also shows the method of transporting stem gears about the factory during the course of manufacture, the work being held in suitable carriers, one of which is shown in the foreground of the illustration.

In the case of stem gears having a splined shaft, like gear *B*, Fig. 5 in the April number, the splines are machined by the hobbing process on a Barber-Colman gear-hobbing machine equipped the same as the job shown in Fig. 12, with a hob that provides for under-cutting the sides of the spline, as at *R*, Fig. 5. This is done to facilitate the subsequent finishing of these spline-ways. Fig. 12 shows a similar operation on a splined shaft, the set-up for the gear being identical with the set-up shown. The operator of this machine also runs a similar machine for rough-cutting the teeth in the stem gears. Production time on the splining operation is thirty stem gears per hour, this also being the production rate for the roughing operation on the gear teeth.

Fig. 13 is a close-up view of a Cincinnati hobbing machine engaged in roughing the teeth in gear *B*, Fig. 8, while Fig. 14 is the finishing operation on this gear as set up on the Fellows gear shaper. The production time for rough-cutting the twenty-nine teeth in gear *B* is 16 gears per hour; for gear *D*, 22 per hour; for gear *E*, 8 per hour; and for gear *F*, 28 per hour. As previously explained, gear *E* is both roughed and finished on a Fellows gear shaper, which accounts for the proportionately long machining time. The finishing operations on the four gears of the cluster are performed at the rate of 4.7, 6, 7, and 8 gears per hour, respectively.

Before the teeth are finish-cut, the ends of the teeth in gears *D* and *E* are pointed on a tooth-rounding machine manufactured by the Cross Gear & Engine Co., Detroit, Mich., and this machine is shown in Fig. 15, engaged in rounding the teeth of gear *E* of the cluster gear. The tool is clearly shown at *A*. This rounding of the teeth facilitates the sliding engagement of the gears when they are in operation. The production time is twenty-eight forgings per hour for each of the gears *E* and *D*. After finish-cutting, the rough edges are next removed and the burrs cleaned off on a speed lathe; this completes the machining operations prior to heat-treatment. Before heat-treating, all work is subjected to another inspection, after which the work is delivered to the heat-treating department, a corner of which is shown in Fig. 16.

Heat-treatment

The heat-treating department is equipped with two Rockwell under-fired carburizing furnaces in which platinum hot-end pyrometers are installed. The gears are packed in semi-steel cast pots, using "Bohnite" carburizing material, manufactured by the Case Hardening Service Co., Cleveland, Ohio. The pots are covered and sealed with fireclay, and in about every fifth one, the cover has a hole through which a test piece extends into the pot so that the depth or case may be tested from time to time. This, of course, is merely an approximate method of ascertaining the condition of the work, and is not relied upon solely to determine when the proper depth of case has been reached. There is included in each lot of work to be carburized a scrap gear; this gear is fractured and the case examined as a further means of checking up the degree of carburization

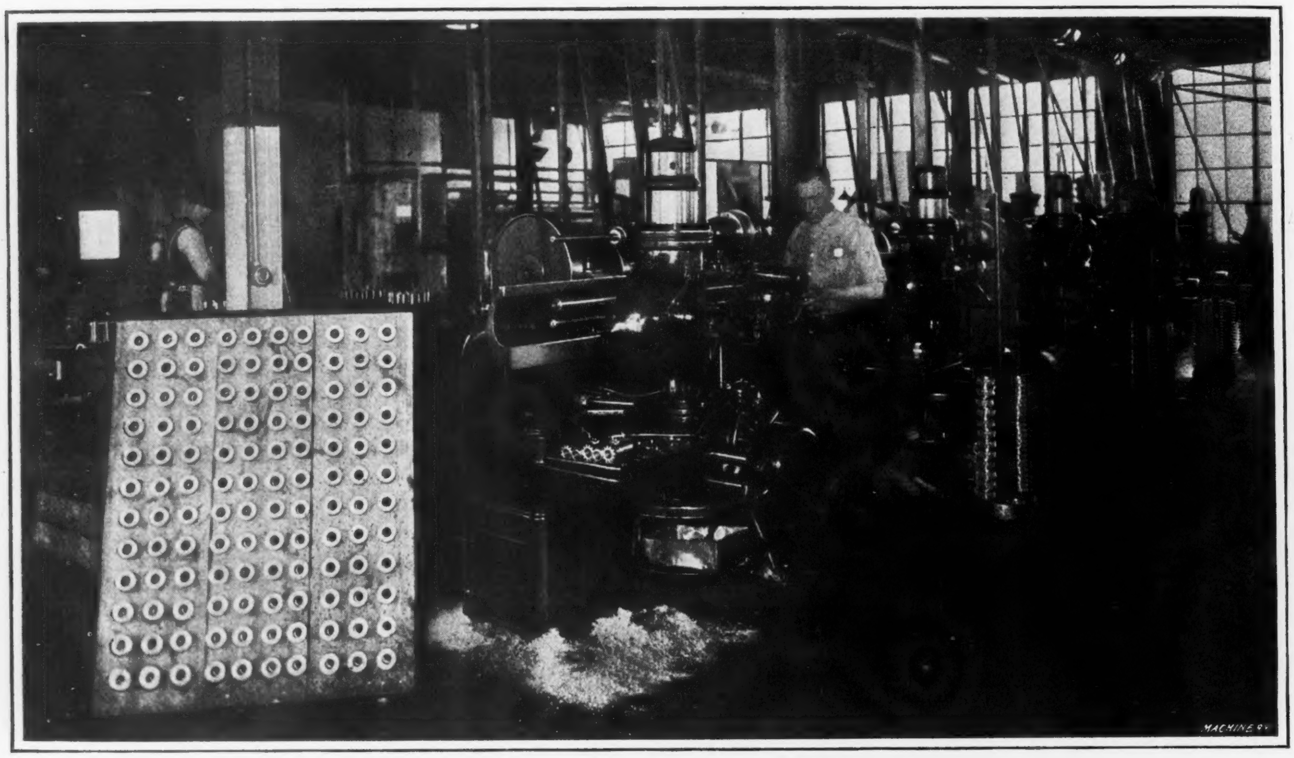


Fig. 11. Section of the Gear-cutting Department, showing a Row of Gear Shapers

that is indicated by the pyrometer. A temperature of from 1650 to 1700 degrees F. is maintained, and the work is permitted to cool in the pots after carburizing.

To prevent the formation of scale during the hardening process, the gears are immersed in molten lead. This is done by stringing them on a poker, which is inverted when the gears are immersed; otherwise, due to the greater specific gravity of the lead bath, the gears would not remain on the poker but would rise to the top of the lead bath. In hardening, a number of Gilbert & Barker lead pot furnaces are employed, and these are equipped with nichrome pots in place of the regular pot furnished with the furnace. The hardening consists of first refining the core at a temperature of 1500 degrees F. and then quenching in oil. This leaves the core in proper condition to give the highest gear service, but the case remains very brittle. In reheating to a temperature of 1325 to 1350 degrees F., the case is refined and the core unaffected. Temperature figures for hardening are, however, more or less flexible, since the greater the carbon contained in the case, the less the temperature required to harden it, and vice versa. From the reheating furnace, the gears are quenched in an oil bath.

In order to realize the most uniform results, the temperature of the oil bath must be kept uniform, and to that end, the oil is circulated by being delivered to the tank from the bottom, and returned to the supply tank by a pipe connection at the top of the quenching tank. The supply tank is located underground and is equipped with water-cooling coils. After casehardening, the gears are tempered in oil at a temperature of 325 to 350 degrees F., thus relieving the hardening strains set up in the case. The tempering furnaces are of the Gilbert & Barker type. These, as well as a wire-mesh basket in which the parts are contained during tempering and rinsing, may be clearly seen in Fig. 16. This illustration also shows some of the other heat-treating appurtenances, including cleaning tanks and hardness testing equipment. The hardening room is equipped with an overhead trolley system by means of which the work is transported from one section of the room to the other. After tempering, the coating of oil left on

Fig. 12. Hobbing Machine employed in cutting Splines in Shafts and Stem Gears

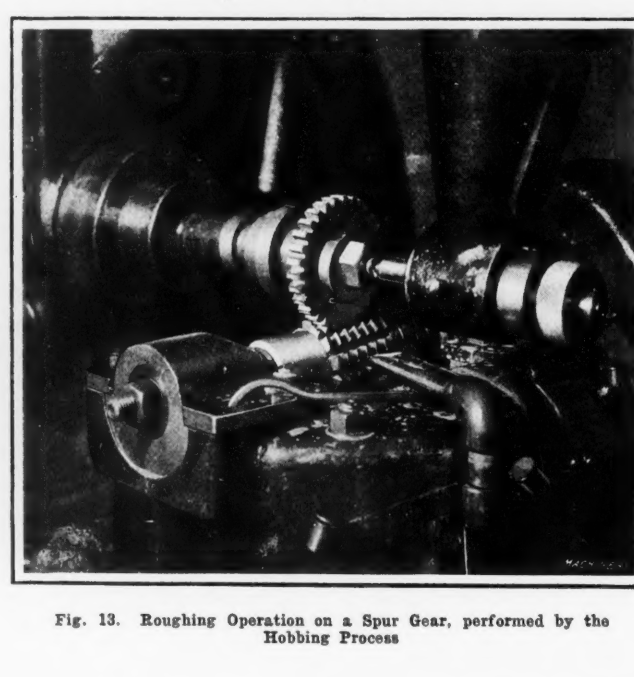


Fig. 13. Roughing Operation on a Spur Gear, performed by the Hobbing Process

the gears is removed by immersing in a tank of mineral cleaner, from which they are quickly withdrawn and then wire-brushed. The oil used for the quenching bath is Houghton's No. 2 soluble quenching oil.

Testing Hardness and Straightening

Every gear that passes through the heat-treating department is subjected to a hardness test by the scleroscope method, a reading being taken on two diametrically opposite teeth. In the case of gear *A*, Fig. 5, it will be seen that the stem end of the gear is drawn to a scleroscope reading of from 50 to 60, but, in general, a reading of from 70 to 85 is required. Long gears of the type shown in Fig. 5 and splined shafts which are likely to warp during heat-treatment are straightened on a 30-ton Lucas power press before being delivered to the grinding department, where the final machining operations are performed. Other auxiliary equipment found in the heat-treating department includes an ordinary lathe with a dial indicator for inspecting the straightness of these long slender parts.

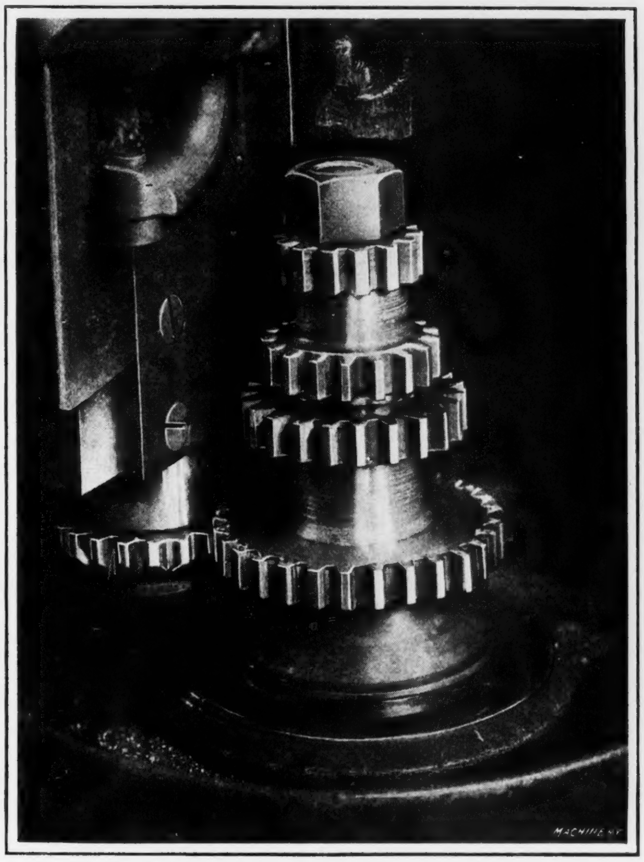


Fig. 14. Finish-cutting the Teeth on a Gear Shaper

Before leaving the heat-treating department, it may be of interest to call attention to the power installation by means of which the oil is pumped to the furnaces and tanks, and the air pressure supplied to the oil burners. A 20,000 gallon capacity storage oil tank is used, from which a rotary oil-pump delivers the fuel to the furnaces. The air pressure is supplied by a Root positive pressure blower, and the quenching oil supply, fuel oil-pumps, and the blower for atomizing the oil, are all driven from one lineshaft, so that in case there is trouble and any one unit is inoperative, the results will not be serious. By this arrangement, when either the quenching oil supply, the fuel oil supply, or the blower is stopped, there remains no possibility of the oil being supplied to the furnace in a stream, rather than in a spray, which might be the case if the blower and fuel supply were operated independently. An additional advantage of this arrangement is that a considerable saving of power and auxiliary equipment for pumping the oil supply is realized.

Grinding Methods

The first grinding operation performed on the stem gears, Fig. 5, after being delivered from the heat-treating department, consists of grinding a 60-degree center, as at *S*. The work is chucked from the pitch circumference in a Johnson gear chuck, made by the Garrison Machine Works, Dayton, Ohio, and is supported at the small end by a regular 60-degree center. In the performance of this operation, any available grinding machine or any lathe equipped with a grinding attachment may be used. The stem gears of the type shown at *A*, Fig. 5, are then ground on surfaces *T*, *D*, and *E*, and the gears of the type shown at *B*, on surfaces *T*, *Q*, and *U*, the operations being performed either on a Landis or a Cincinnati cylindrical grinder, with the work supported between centers as shown in Fig. 17. This illustration shows a Cincinnati grinder engaged in grinding surface *E* of gear *A*, Fig. 5. The grinding wheel used on this operation is a Norton, grade 6660CM, 18 inches in diameter and 2¼ inches face width, and the production time is fifty ground gears per hour.

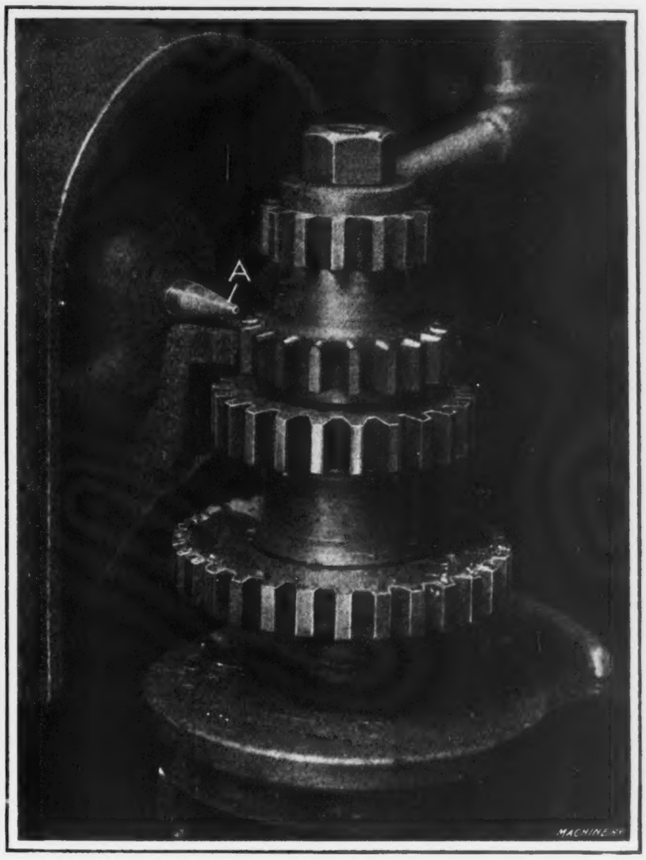


Fig. 15. Gear Rounder machining the Ends of the Teeth

These ground surfaces, being located from the center line of the gears, are used as the registry surfaces during the grinding operations which follow. The central hole *I* of the stem gears may be finished either by grinding or by reaming. In the case of gear *B*, the work is ground in an internal grinding machine. In the gear shown at *A*, this hole is finished by reaming, but the work is chucked from the bearing surface, as in the case of grinding the hole of gear *B*, so that the same relationship is established.

The only grinding operation required in finishing the cluster gear, Fig. 8, is that of grinding the central hole, and this operation is illustrated in Fig. 18, which shows a Worcester bore grinder, equipped with a special Garrison gear chuck having provision for clamping the work by the large and also by the small gear. Aside from the fact that the chuck is of duplex construction, it is not different from the regular gear chucks of this type. By this special provision, the concentricity limit of 0.003 inch between the central hole and the pitch line may be readily maintained. The

Fig. 16. Heat-treating Department, showing Furnaces, Quenching Tanks, and Hardness Testing Bench

production time on this operation is four gears per hour, and a Norton grinding wheel (grade 6660 L) 1 1/8 inches in diameter and 5/8 inch wide is used.

Inspection

The inspection of all gears manufactured in this plant is one of the most painstaking and carefully conducted operations to which the work is subjected. The gears are inspected, as has been explained, in the rough, before the teeth are cut, after they are cut, just before being heat-treated, and finally after grinding. At the beginning of any operation, one gear is always inspected before the operator is permitted to proceed. After the inspection has been concluded, if the work is satisfactory, it is then necessary for the operator to submit a piece to be inspected every hour during the day. This practice is insisted upon, and the results of this hourly inspection are indicated by a card such as shown in the lower part of Fig. 19. This card is self-explanatory, and shows the punch marks which indicate that the gear has received the inspector's attention. Each gear that is inspected, is stamped at the time of inspection, and this prevents the workmen from submitting the same piece from hour to hour.

The inspection is divided into two sections, one for the intermediate stage of manufacture and one for the final inspection, but the same general scheme is followed in both, in maintaining the desired quality of output. The inspector is required to fill out a daily report, which is shown in the upper part of Fig. 19, so that the chief inspector may be advised as to the amount of work going through and the quality of the work. A reason is also given for the cause of rejected work so that a cue is furnished for correcting any factor which may need such attention. In addition to the stationary inspectors, there is a roving inspector whose duty it is to pass around through the shop frequently during the day.

Before any gears are passed to the gear-cutting department, they are given a final 100 per cent inspection. Gears

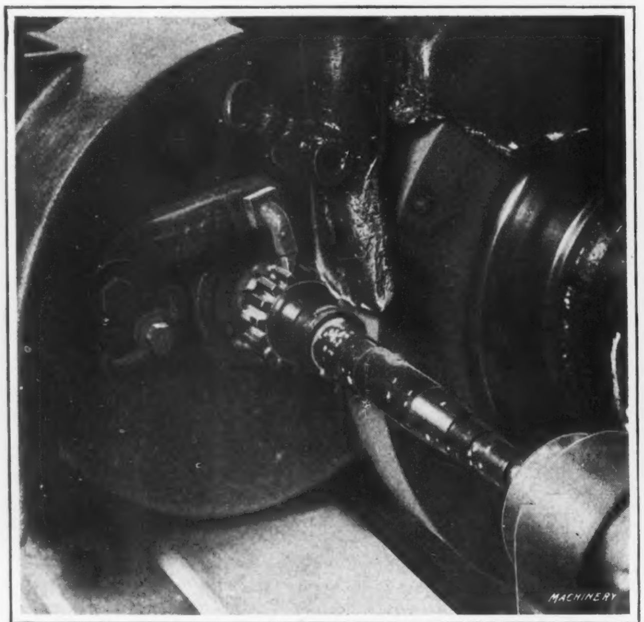


Fig. 17. Grinding Bearing Surface of Stem Gears

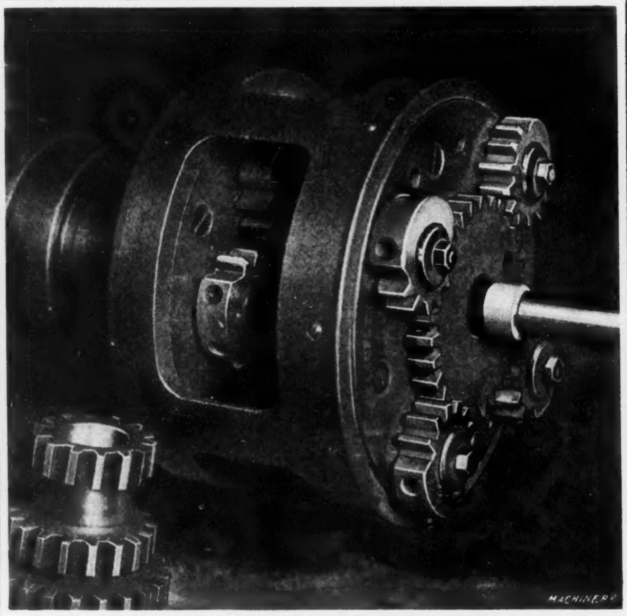
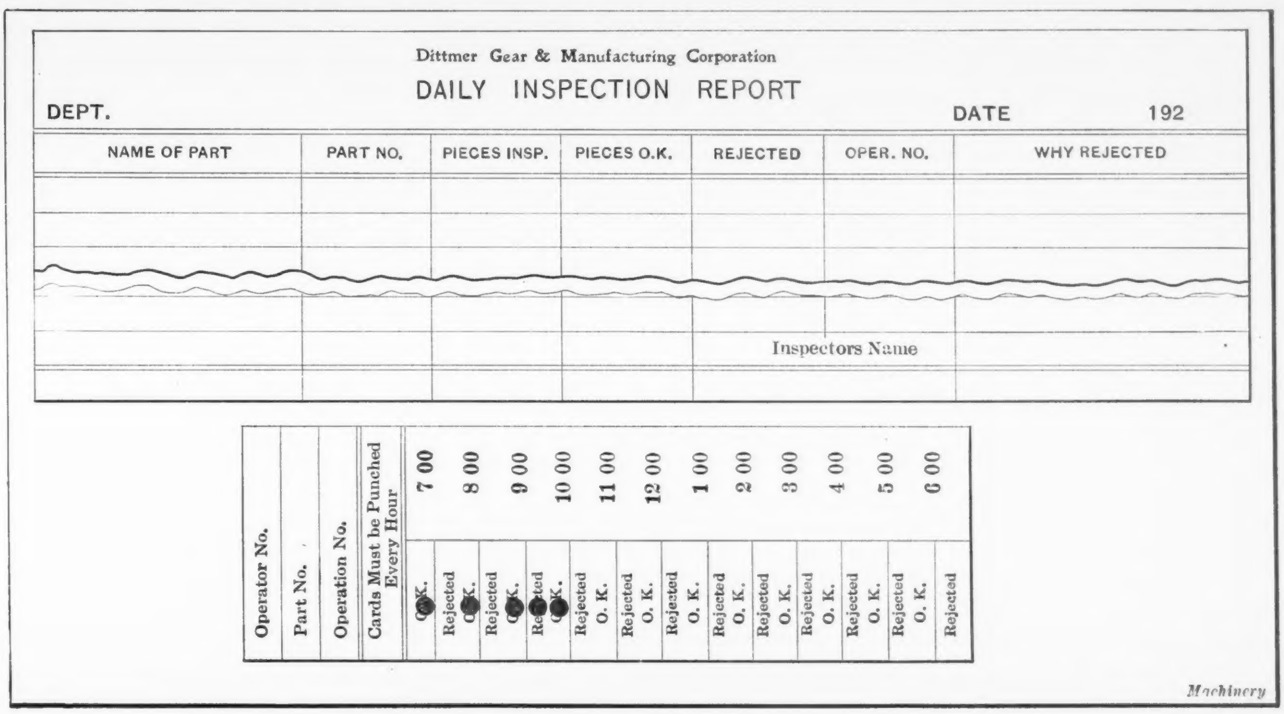


Fig. 18. Grinding the Bore of an Automobile Cluster Gear

that do not meet the requirements are suitably tagged, and are not permitted to go on. Work which is tagged in this way is brought to the attention of the chief inspector, who uses his judgment to determine whether or not the gear can be salvaged, and if so, means are taken in the salvaging department to correct the faults so that the gear may pass inspection. If the gear cannot be salvaged, it is mutilated so badly that it will not be possible to use it, thus preventing the possibility of its getting into the work which has been already passed. It will thus be seen that those gears which pass to the gear-cutting machines are in such a condition that no distortion, or any error in cutting teeth, can be traced back to the roughing-out operations. This simplifies the final inspection and confines it principally to the gear teeth and the concentricity of the pitch line with the bearing surfaces.

The heading illustration is a view of the final inspection bench and shows the Brown & Sharpe vernier testing machine, and a collection of gears of various types. This illustration gives an idea of the variety of gears manufactured in connection with automobile work. There are a great number of micrometers used in inspecting, and these are regularly checked by means of gage-blocks, so that errors will not be permitted to creep into the inspection work due to inaccuracies in measuring. For testing the concentricity of the gears and the perpendicularity of the face with the bore, Brown & Sharpe bench centers are used. The inspectors are rewarded for perfect shipments, so that each gear receives conscientious attention, which tends to eliminate the possibility of passing gears that do not quite come within the specified requirements.

Although only a few typical examples of automobile gears have been dealt with in this article, these illustrate the general practice as applied to all gears that pass through this factory. Any further description of other gears would serve no particular purpose, for it would only be a repetition of the machining methods described in connection with the stem, cluster, and camshaft gears which have already been mentioned. Nothing has been said specifically relative to the machining of gears cut from alloy bar stock, but since these represent a type that is different from others only in its first stages of manufacture, it will be apparent that the machining operations required are not of a special nature and are along the same general lines as previously described.


Dittmer Gear & Manufacturing Corporation

DAILY INSPECTION REPORT

DEPT. DATE 192

NAME OF PART	PART NO.	PIECES INSP.	PIECES O.K.	REJECTED	OPER. NO.	WHY REJECTED

Inspectors Name

Operator No.	Part No.	Operation No.	Cards Must be Punched Every Hour	7 00		8 00		9 00		10 00		11 00		12 00		1 00		2 00		3 00		4 00		5 00		6 00	
				O. K.	Rejected	O. K.	Rejected	O. K.	Rejected	O. K.	Rejected	O. K.	Rejected	O. K.	Rejected	O. K.	Rejected	O. K.	Rejected	O. K.	Rejected	O. K.	Rejected	O. K.	Rejected	O. K.	Rejected

Machinery

Fig. 19. Inspector's Daily Report Slip and Workman's Operation Card

GERMAN MACHINERY IN HOLLAND

Of all the machinery exported to Holland in 1920, including labor-saving machinery and machine tools, textile machinery, engines, motors, etc., amounting in all to about $35,000,000 at an average rate of exchange, Germany has furnished according to a recent *Commerce Report*, at least two-thirds. Of the machine tools, amounting to about $17,000,000 in value, the proportion from Germany was almost three-fourths. Germany sent six-tenths of the $3,500,000 worth of textile machinery imported, almost half of the $3,000,000 worth of internal-combustion engines, about 55 per cent of the $5,500,000 worth of electrical installations imported, and about 80 per cent of the $6,000,000 worth of electric motors, transformers, and the like. In machine tools, in which the United States at one time had all but a dominant share of the trade, the year's business has been very largely German. These tools have been imported at such prices as to cause a rush to equip all factories, with the result that American and other business for the future in this line is all but destroyed.

The chief reason for the large German export lies in the low value of the mark and the consequent low cost of machines in Dutch gold. There has also been a good deal of change in the nature of the business, since a considerable number of small Netherlands firms have gone into the machine import business. Proximity of the producing factories and favorable exchange has enabled these small firms to handle business formerly confined largely to old established and larger firms that had American and British connections. German manufacturers and dealers in nearly all such lines of goods have opened branch houses in Rotterdam, Amsterdam, the Hague, and other centers, and have gone after the trade themselves. The high exchange value of the dollar, or rather the comparatively low buying power of the Dutch guilder, has had a material influence in shaping the course of trade in machinery lines. Aside from the German supplies, most of the machinery imports come from Great Britain, whose trade is aided by the fact that the pound sterling and the guilder are more nearly at a par value. These results of the general exchange situation have been materially increased by the fact that many Dutch importers had considerable funds in German marks when the latter fell in value, and it was necessary to take goods from Germany to prevent increased losses.

Manufacture of Socket Wrenches

By P. BALDUS

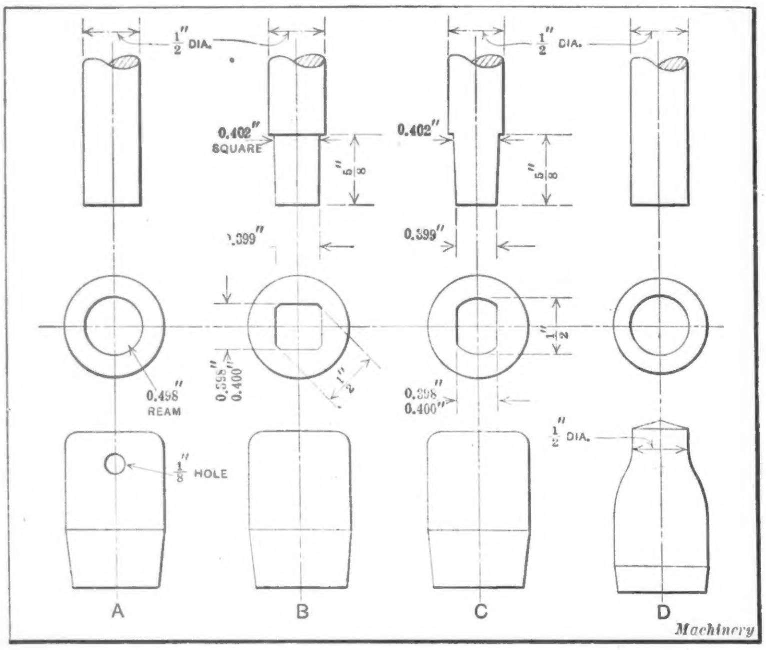


Fig. 1. Various Types of Wrench Handle Ends and Corresponding Sockets

SOCKET wrenches are manufactured by a large number of concerns, but their design, the dimensions of the various sizes, and the material from which they are made are practically the same for all makes. There is quite a variety of styles, including long tee, short tee, offset, bit-brace, L-handle, Z-handle, etc., the principal differences being in the design of the handle. Diverse methods are also employed in attaching the handles to the sockets. In this article, information concerning the manufacture of hexagonal socket wrenches will be presented, which will include the dimensions of sockets, the manner in which the latter are attached to the handles, and the machining methods employed in producing the sockets.

Handles for the smaller sizes of socket wrenches are usually made from 7/16-inch diameter steel, while ½-inch stock is used for the larger sizes. The material chiefly used is commercially known as "bright soft basic wire." Both the sockets and handles of Ford wrenches are made from a steel having the following analysis: Carbon, 0.15 to 0.20 per cent; manganese, 0.30 to 0.40 per cent; sulphur, 0.045 per cent and less; phosphorus, 0.040 per cent and less; and silicon, 0.07 to 0.14 per cent.

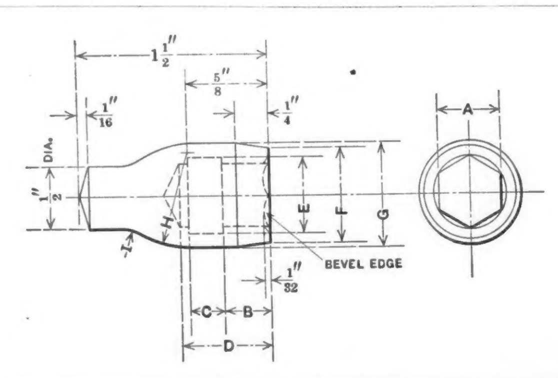
Methods of Attaching Handles to Sockets

Various methods are employed for attaching the wrench handles to the sockets, the most popular being to pin, rivet, or weld them together. Fig. 1 shows the way in which the handle ends and the corresponding socket holes are machined when the parts are assembled by any of these methods. The handle ends are shown in the row at the top of the illustration, and the sockets in the two rows at the bottom. In the style shown at *A*, the end of the handle is forced into the reamed hole of the socket and then pinned to it. In the styles shown at *B* and *C*, the handle ends are pressed into the sockets and then riveted through the inside of the sockets. The style shown at *C* is somewhat stronger than that illustrated at *B*. In both cases, the torsional strain is transmitted through the flat faces of the parts. The handle and socket shown at *D* are secured to each other by a butt-welding operation. This is the strongest connection of the four illustrated, provided the welding operation is done well. After the parts are welded together, the joint is ground smooth.

Screw Machine and Punch Press Operations on Sockets

Dimensions of different sizes of butt-welded wrench sockets for attachment to ½-inch diameter handles are given in the accompanying table. These sockets are turned and drilled in a four-spindle Gridley screw machine, and then recessed on a machine especially designed for the purpose. By supplying suitable fixtures, the recessing operation could, no doubt, also be accomplished in the screw machine. The sockets are then transported to the punch press department, where the hexagonal opening is punched in one operation on a back-geared Toledo press, the sockets being held securely in a locating fixture bolted to the machine. Centering bushings are provided for each size, these bushings being made of machine steel and casehardened and ground. They are

DIMENSIONS OF BUTT-WELDED WRENCH SOCKETS, IN INCHES



Size	7/16	½	9/16	19/32	⅝	11/16	¾	25/32	13/16	⅞
A	29/64	33/64	37/64	39/64	41/64	45/64	49/64	51/64	53/64	57/64
B	⅜	⅜	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16
C	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼
D	11/16	11/16	¾	¾	¾	¾	¾	¾	¾	¾
E	0.533 0.543	0.605 0.615	0.676 0.686	0.712 0.722	0.748 0.758	0.820 0.830	0.892 0.902	0.930 0.940	0.966 0.976	1.040 1.050
F	11/16	¾	25/32	⅞	⅞	1	1 1/16	1⅛	1⅛	1 3/16
G	¾	13/16	⅞	15/16	1	1 1/16	1⅛	1 3/16	1 3/16	1¼
H	¾	¾	¾	¾	¾	⅝	⅝	⅝	⅝	½
I	⅜	⅜	⅜	¼	¼	¼	¼	3/16	3/16	¼

Machinery

attached to the fixture by fillister-head machine screws, and are readily interchangeable.

The design and dimensions of the punches used in producing the hexagonal openings in the sockets are shown in Fig. 2. The various lengths of these punches are identical, the only dimensions varying being the diameters and the distance across the flats on the punching end. These punches are made from a special tool steel, and are hardened and ground. Considerable trouble was experienced at first, due to the sockets adhering to the punches, which were first made of an ordinary tool steel. By employing a special tool steel for the punch and using certain lubricants, the stripping of the sockets was successfully effected. Buttermilk was found to be a very satisfactory lubricant for the operation. The stripper was made from a tool-steel plate, 1 inch thick, and fastened in an ordinary manner to the punch, being operated by the knock-out mechanism on the machine. When the drilled hole in the socket is equal to, or a few thousandths inch smaller than, the distance across the flats of the hexagonal opening, it is necessary to have a ⅛-inch hole through the center of the punch (see Fig. 2) to permit the escape of air and prevent bursting of the socket walls.

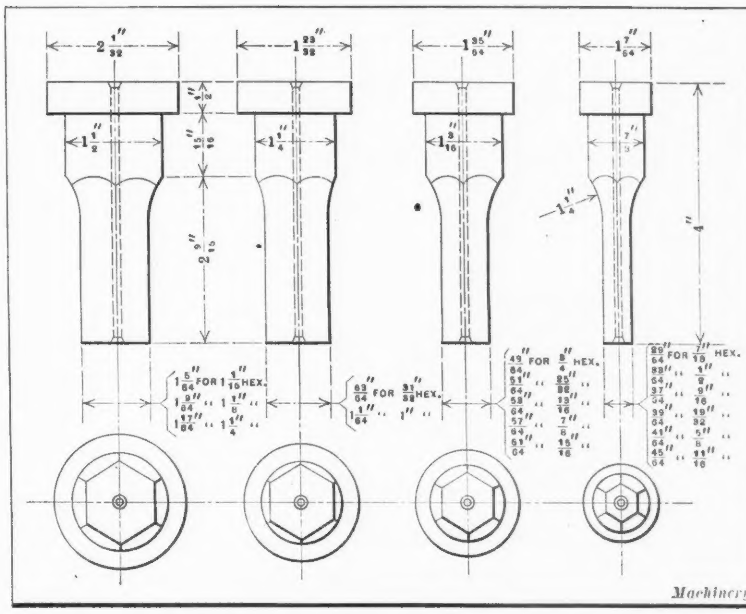


Fig. 2. Dimensions of Punches for Hexagonal Holes in Wrench Sockets

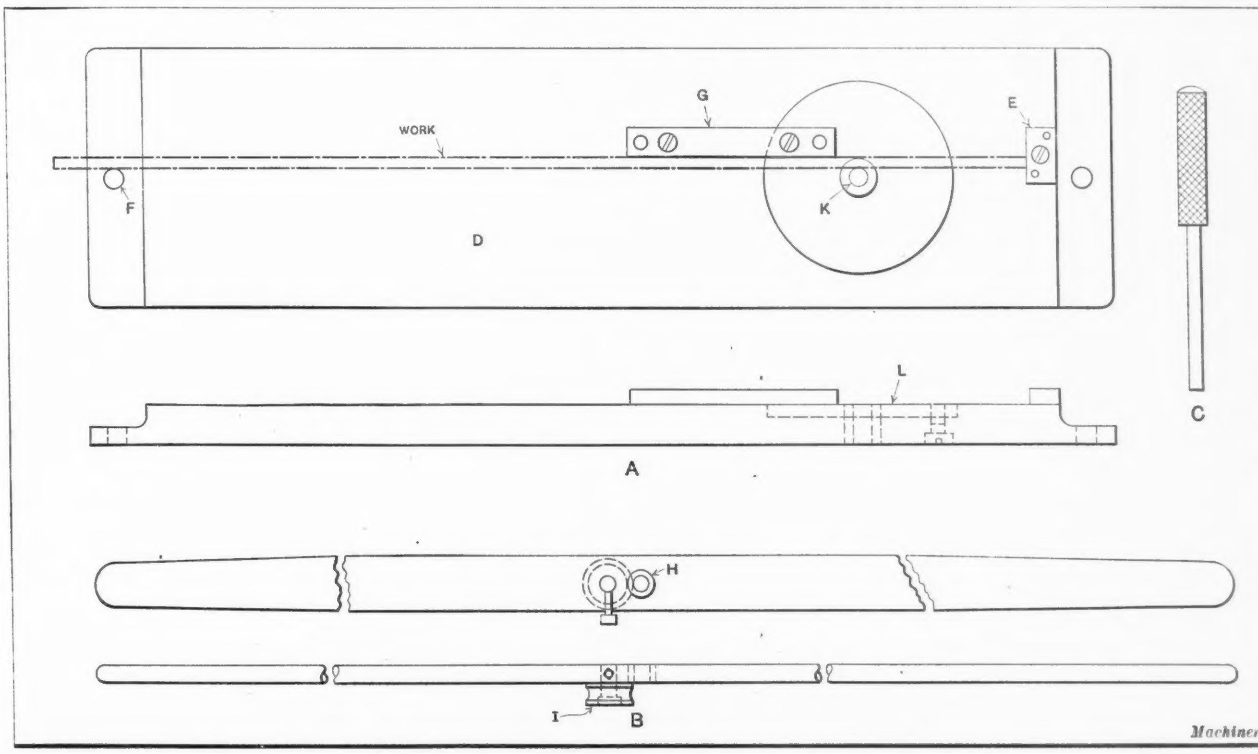


Fig. 3. Fixture used in bending T-handle to Shape shown at A, Fig. 4

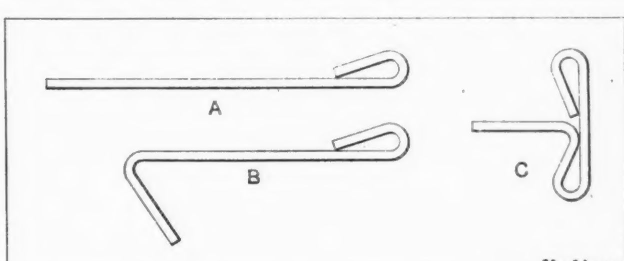


Fig. 4. Different Steps in the Making of a T-handle

Bending the Wrench Handles

T and offset handles are generally bent by hand in three operations, as indicated in Fig. 4. Fixtures of the general type illustrated at *A* in Fig. 3 are employed for the bending operations, this particular fixture being used in making the first bend. In operation, the work is placed on base *D*, as indicated by the heavy dot-and-dash lines, being properly located by stops *E* and *F*, and block *G*. Handle *B*, which is about 5 feet long, and provided with a steel bushing *H* and a hardened roller *I* near the center, is then attached to the fixture by inserting pin *C* through bushing *H* and into bushing *K*, the roller *I* on the handle being in contact with the hardened steel plate *L* in the base. Roller *I* is on the opposite side of the work in relation to the position of pin *C*, and so, when the handle is gripped at each end and turned about pin *C*, the work is bent to the shape shown at *A*, Fig. 4. Some manufacturers produce handles for "speeder" wrenches in two operations on a punch press, while others prefer to bend them by hand on similar fixtures to that described. After the sockets have been welded to the handles, the wrenches are ground, and then sent to the finishing department, from which they go to the shipping department.

Manufacture of Heavy-duty Helical Springs

An investigation of the general practice of spring-makers in an endeavor to find a way of manufacturing helical springs for transmitting the driving power of a motor to the wheels of an electric locomotive, was discussed in a paper read before the American Society for Steel Treating by T. D. Lynch, research engineer, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. The arrangement of the springs was such as to permit free vertical and lateral wheel play. In this application, tensile, compressive, torsional, and shearing stresses are produced, separately or in combination, and these stresses are augmented from time to time by shock, producing a condition that makes necessary a material having great elastic strength and a high degree of toughness. The investigation disclosed the fact that the general process in use for the manufacture of springs from bars larger than 3/8 inch in diameter is to obtain bars produced in large open-hearth furnaces and rolled in a commercial manner. Bars thus made are heated until the color ranges from a bright to a dull red, are coiled into springs, and quenched from this irregular coiling temperature. It is needless to say that springs made by such a process cannot be depended upon in severe service.

Spring steel, and especially an alloy spring steel, cannot be too carefully made, nor too carefully coiled and treated in order to produce a strictly reliable finished product. The author of the paper proposed a process for manufacturing heavy-duty springs made from silico-manganese steel 1 inch in diameter although many other alloy steels could be used. The process includes the making and rolling of the steel, and the coiling, treating, testing, and inspection of the spring. The important parts of this method are outlined in the following:

The silico-manganese steel used should be of the following chemical analysis, both in the ladle test and the check test from finished rolled bars: Carbon, 0.50 to 0.60 per cent; manganese, 0.60 to 0.80 per cent; phosphorus, not over 0.04 per cent; sulphur, not over 0.04 per cent; and silicon, from 1.90 to 2.20 per cent.

Manufacturing the Steel

The steel should be made by the crucible or electric furnace process, the ingots being not less than 9 inches square at the large end and 8 inches square at the small end. The steel should be poured and the molds coated in such a way as to give a smooth surface to the ingots. Each ingot when cold should be carefully inspected and all blemishes chipped or ground out, leaving a surface which will be free from laps or seams after rolling.

The ingots should be slowly and carefully heated to approximately 2000 degrees F., rolled or forged square to about 3 by 3 inches, and sheared into suitable billet lengths for final rolling. Excessive reduction should not be permitted. Sufficient discard should be made so that no signs of piping or segregation will be found when careful inspection is made. The billets should be allowed to become cold, and a careful inspection made for surface defects. Any slight blemishes should be ground out, leaving a smooth even surface without ragged corners or slivers. The billets should then be heated to approximately 2000 degrees F. and rolled to the finished size, great care being taken to avoid excessive reduction at any one pass.

The bars resulting from this operation should be sheared to length, and carefully inspected for piping, segregation, and surface defects. Each bar should be straight, free from surface cracks, scratches, seams, folds, and indentations, and true to section. The diameter of the bars should not vary more than 2½ per cent from that specified. All bars should be tied in bundles and a metal tag securely attached to each bundle, this tag having stamped on it the requisition number, the heat number, the size of the bar, and the identification mark of the manufacturer. When the bundles are opened, great care should be exercised so as not to nick or in any way injure the bars, as even slight defects should not be permitted.

Coiling and Heat-treating the Springs

Preparatory to coiling the springs, the bars should be heated slowly to a uniform temperature of approximately 1700 degrees F., and immediately coiled over a mandrel preheated to at least 212 degrees F. The mandrel should not be water-cooled, nor should any water be allowed to touch the spring while hot. Notching for length should be done at a dull red heat, and in such a manner as not to cut, scratch, or injure the surface at any other point on the spring.

After notching, the springs should be allowed to cool slowly and uniformly in such a way as to prevent local chilling which might cause surface stresses or cracks. Then the coiled springs should be slowly and uniformly heated to approximately 1290 degrees F., transferred to a furnace held at a quenching temperature of 1650 degrees F., and uniformly heated as near as possible to this temperature, after which they should be quenched in oil. The quenched springs should then be tempered in a salt bath having a temperature of approximately 850 degrees F. in order to relieve the stresses produced by quenching. The tempered springs should be cleansed from the adhering salt by employing a hot soda wash, following with an oil or lime dip to protect them from corrosion.

Determining the Physical Properties of the Springs

The tests employed to determine the physical properties of the springs should be performed in the order to be given, during which the springs should not be rapped or otherwise disturbed.

Solid Height—The solid height is the perpendicular distance between the plates of the testing machine when the spring is compressed solid with a test load of at least 125 per cent of that necessary to bring all the coils in contact. The solid height should not vary more than 1.5 per cent from that specified.

Free Height—The free height is the height of the spring when the load specified in the test for determining the solid height has been released. This free height is determined by placing a straightedge across the top of the spring and measuring the perpendicular distance from the plate on which the spring stands to the straightedge, at the approximate center of the spring. The free height should not vary more than 1.5 per cent from that specified.

Loaded Height—The loaded height is the distance between the plates of the testing machine when the specified working load is applied. The loaded height should not be more than 1.5 per cent over, nor more than 0.75 per cent under that specified.

Permanent Set—The permanent set is the distance between the free height and the height after the spring has been compressed solid three times in rapid succession with the test load specified in the solid height test. Both measurements are to be taken at the same point and in a similar manner. The permanent set should not exceed 0.4 per cent of the free height.

Hardness Test—The Brinell hardness number should not be less than 375 nor more than 450. This test should be

made on the coupon resulting from notching to length and which is broken off after the spring has been heat-treated.

Structure—The grain structure of the finished spring should be troostitic or troosto-sorbitic.

Inspection of the Springs

The springs should be straight, of a uniform pitch, and remain straight throughout the working range. The diameter of the single coils should conform to the tolerance given on the drawing. The concentricity of the coils should be determined by means of plug and ring gages extending the full length of the spring. When the length of the spring is 10 inches or less, the outside diameter of the plug gage should equal the specified inside diameter of the spring minus 0.063 inch, and the inside diameter of the ring gage should equal the specified outside diameter of the spring plus 0.063 inch.

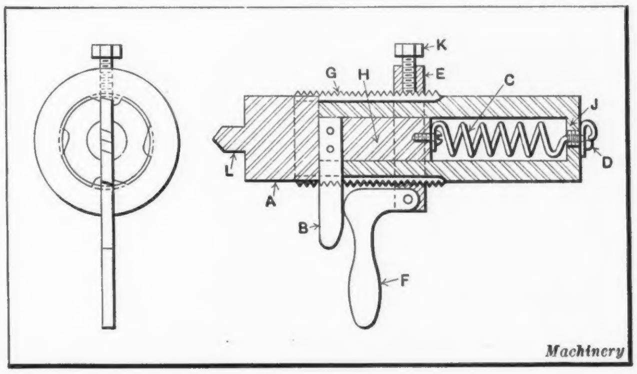
When the length of the spring is over 10 inches, the outside diameter of the plug gage should equal the specified inside diameter of the spring minus 0.094 inch, and the inside diameter of the ring gage should equal the specified outside diameter of the spring plus 0.094 inch. When the drawing specifies a spring with ends squared, and the spring is placed with either end on a flat plate, the axis of the spring should not be at an angle of more than 5 degrees with a perpendicular to the plate. Springs varying from the required finished dimensions may be reheated and reset, but all such reset springs should also be requenched and retempered.

* * *

COMBINATION TAP AND DRILL

By HARRY MOORE

The tool here illustrated may be of interest to readers of MACHINERY who have occasion to machine large quantities of brass packing nuts and other similar brass work. This tool was designed to fit an adapter which, in turn, fitted the tailstock spindle of a lathe. After making tap *G* in the ordinary manner, it was drilled to take the shank *H* of a flat drill *A*, a thin wall *J* being left at the back end of the shank. A slot was then cut in the tap the width of the flat portion of drill *A*. The drill shank *H* was next ground to fit the hole in the tap. A slot was also cut in shank *H* into which the flat stop *B* was fitted and pinned. It will



Combination Tap and Drill

be noted that a spring *C* is attached to the end of shank *H*. The other end of this spring passes through a hole drilled in screw *D* which holds it at this point.

Collar *E* is threaded to fit the tap, and is kept from turning by cap-screw *K*. This collar is slotted to receive lever *F*. When ready to tap, the operator pushes lever *F* to the right. This movement permits extension spring *C* to pull the drill back until stop *B* comes in contact with collar *E*. The cutter *A*, used in this particular tool was designed for drilling two concentric holes. The small section or end of the drill at *L* in this case was allowed to project beyond the tap when tapping the hole. To bring the drill back into its operating position, lever *F* is pushed to the left.

ARE THE SOUTH AMERICAN COUNTRIES METRIC?

By C. C. STUTZ
Secretary, American Institute of Weights and Measures, New York

It is stated over and over again by the metric promoters that to develop trade with our neighbors to the south it will be necessary for us to adopt the metric system, because the South American countries are asserted to be metric. Some of our government agencies, notably the Department of Commerce, are defending this view, and at the Pan-American Congress resolutions to this effect were passed, all predicating their stand on a belief that Latin-American countries have abandoned their old measures.

On the other hand, the opponents to the compulsory introduction of the metric system in the United States have contended that compulsory metric laws passed in South American countries have simply aggravated existing conditions by adding new units of weights and measures to the old ones. In other words, the remedy proved worse than the disease.

In 1919, F. A. Halsey, of the American Institute of Weights and Measures, published in his book "The Metric Fallacy" the results of an extended investigation into South American weights and measures conditions. The reports from the different countries confirm the claims of the anti-metric party and justify the oppositions of those opposed to the compulsory introduction of the metric system in the United States.

During the latter part of 1919, but more especially during 1920, the Department of Commerce asked all United States consuls in foreign countries to report on the use of the metric system in the respective countries. Some of the answers to the department's inquiry were published in the *Commerce Reports;* the greater part however, remained unpublished. Recently these unpublished reports were made available for inspection. In December, 1920, similar reports were obtained from foreign consuls stationed in the United States.

In the lists given below are named the various countries which, according to the statements in the "Metric Fallacy," the Department of Commerce consular reports, and reports from their own consuls, suffer from confusion due to a double and in many cases a triple standard of weights and measures. The findings of the "Metric Fallacy" are thus officially confirmed.

The South American countries reported on in "The Metric Fallacy" are: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Guatemala, Mexico, Haiti, Nicaragua, Panama, Peru, Porto Rico, San Salvador, Honduras, Uruguay, and Venezuela.

The countries reported on in *Commerce Reports* issued by the Department of Commerce are:

South American—Argentina, Bolivia, Brazil, Chile, Guatemala, Haiti, Peru, San Salvador, Uruguay, and Venezuela.
Other Foreign Countries—Bulgaria, Denmark, Turkey, and Norway.

The countries from which the Department of Commerce received reports, these reports remaining unpublished, but now available for public inspection, are:

South American—Argentina, Brazil, Colombia, Cuba, Mexico, Nicaragua, Panama, Paraguay, Peru, San Salvador, Uruguay, and Venezuela.

Other Foreign Countries—Austria, Finland, Hungary, Japan, Netherlands, Portugal, and Spain.

The South American countries reported on by their own consuls stationed in the United States are: Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Mexico, Nicaragua, Panama, Peru, and San Salvador.

Abstracts from the unpublished reports mentioned in the foregoing are given below:

Argentina—From Consul General W. Henry Robertson, Buenos Aires, Argentina, under date of February 13, 1920:

"According to Carlos Aubone, now chief of the Section of Industries of the National Bureau of Commerce and Industries, both laws Nos. 52 and 845 have largely failed of their objects." The author then quotes from *La Prenza* for December 3, 1919, as follows: "The Minister of Agriculture arranged yesterday to send a note to the Department of the Interior, pointing out the propriety of indicating to the provincial and municipal authorities the necessity of exercising a greater vigilance for preventing the frequent violations of the law regarding the decimal metric system. * * * The gallon is used commonly in our country as a measure of capacity for sales of mineral oils, naphtha and paints. There is also used very commonly the bushel as a dry measure. The same thing happens with the foot (pie) measures used improperly in transactions in wood, and also with the pound (libra) for the purchase and sale of tea. * * * The unit vara is used in place of the meter for transactions covering land in the federal capital and suburban centers."

Brazil—From Consul General A. T. Haeberle, Rio de Janeiro, Brazil, under date of August 25, 1920: "The metric system for weights and measures was adopted by the federal legislature of Brazil during 1863 and entered officially as the sole legal standard of the country on January 1, 1864. In the vast interior the measures introduced by the early Portuguese settlers are still somewhat in use. * * * The garaffa (bottle) persists in both cities and country, and the vara (1200 meters) persists in the interior. Especially in the case of land measure the old units are still in use. * * * The English measures, particularly feet and inches, are commonly used in Brazil in those trades where the machinery and materials are imported from the United States and England. * * * The textile industry is the most extensive manufacturing industry in Brazil, and as the machines are almost entirely imported from England or the United States, widths of cloths are commonly given in inches. Carpenters frequently use the English foot and inch."

Colombia—From Bogota, Colombia, under date of August 31, 1920: "The decimal metric system is the only legal system in Colombia. In business transactions, use is generally made of the arroba (25 pounds of 500 grams), of the vara (80 centimeters) and of other capricious measures of weight and length, but these are not legally recognized."

Cuba—From Vice-consul S. B. Cosmer, Havana, Cuba, under date of June 30, 1920: "The International metric system is the sole legal standard of the Republic of Cuba. * * * The circumstances described have resulted in the almost universal retention of certain of the old Spanish weights and measures in the retail trade here and to nearly as great an extent in the trade of local wholesalers. The use of the 'libra' and 'vara' are almost universal. * * * The 'arroba' which is twenty-five Spanish 'libras' is a term in very general use in the interior of the island."

Nicaragua—From Benjamin Jefferson, American Minister, Managua, Nicaragua, under date of September 2, 1920: "The metric system is the legal standard of weights and measures in Nicaragua. Due to the fact that considerable trading is done with the United States, many of the people of this republic, especially on the Atlantic coast, use weights and measures as used in the United States."

Panama—From the American Consul General, Panama, under date of November 7, 1919: "The metric system is the legally adopted standard of the Republic of Panama. However, throughout commercial circles the English system of weights and measures is universally used, the only exception being real estate transactions. The natives of the interior of Panama know nothing of the meter and other metric terms. * * *"

Paraguay—From Consul Henry H. Balch, Asuncion, Paraguay, under date of January 16, 1920: "According to the law of Paraguay the metric system of units is legal in this country, and is the system of weights and measures in general use. In addition to the metric units the following old units of weights and measures are still used to some extent in Paraguay. (Here follows a table of 19 non-metric units.)"

Peru—From Vice Consul James H. Roth, Callao-Lima, Peru, under date of July 12, 1920: "The metric system is a legal standard of weights and measures in Peru, as a law was passed on December 16, 1862, establishing this system throughout the republic. From July 28, 1869 the metric system has been used in all of the public offices of the government, but the commercial houses still used the old Spanish system of weights and measures until the Municipal Council of Lima on April 12, 1916 ordered that all commercial firms use the metric system. However, authority has been granted by special laws to collect certain export charges, as those on sugar and cotton * * * per Spanish hundredweight."

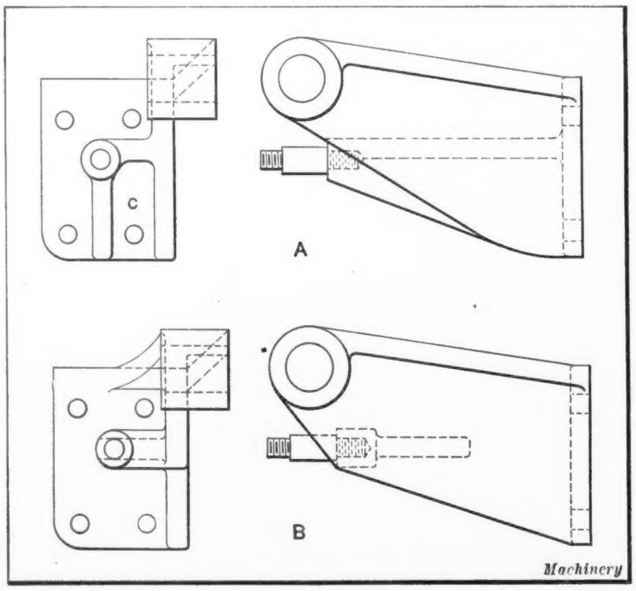
San Salvador—From Vice Consul Lynn W. Franklin, San Salvador, under date of January 9, 1919: The Vice Consul includes a letter from the Foreign Office of the Republic of El Salvadore, which gives particulars regarding legislation for the adoption of the metric system and then proceeds as follows: "But in private practices other units are of common use. * * * It will be some time yet before that system [metric] may be used in all its extensions."

* * *

SIMPLIFYING THE DESIGN OF A SHAFT BRACKET

By M. E. DUGGAN

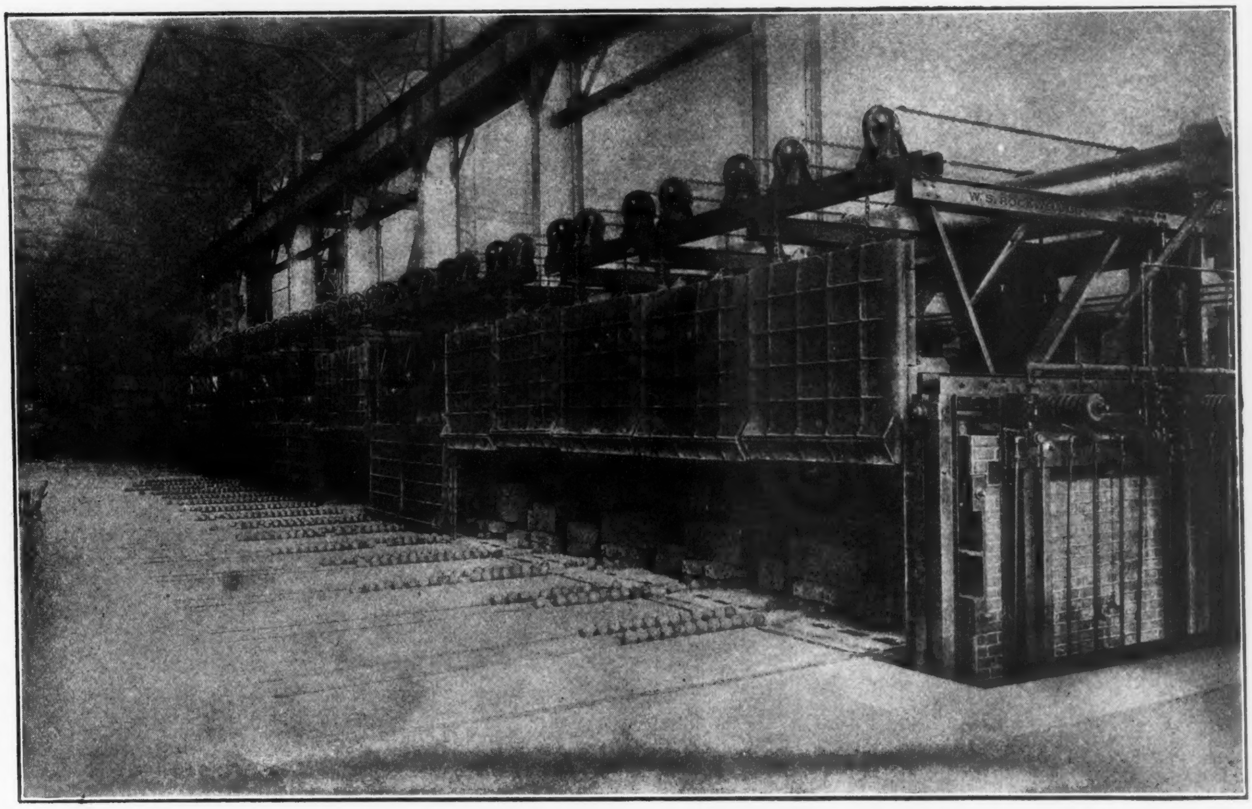
The following example serves to show why it is important for a draftsman to have a fairly good knowledge of patternshop and molding-room practice, and why he should always consult the patternmaker before sending a pattern drawing into the shop if he does not know exactly how the piece he has designed can be molded. In the accompanying illustration at *A* is shown a cast-iron bracket designed by a draftsman who had practically no knowledge of patternmaking and



(A) Shaft Bracket as originally designed. (B) Shaft redesigned to simplify Production

foundry practice. Unlike many draftsmen, however, he was anxious to cooperate with the patternmaker, with the purpose in view of simplifying the work of patternmaking or molding.

The bracket with the changes recommended by the patternmaker is shown at *B*. It will be seen by those familiar with molding practice that the few simple changes in the original design made it possible to produce suitable molds without the use of cores such as would be required to form the pocket *C* of the original design. By thus simplifying the design so that the part could be more easily cast a saving in both time and money was effected.



Car and Car-and-Ball Furnaces

Relative Merits ot Heat-treating Furnaces of the Car and Car-and-Ball Types

IN heat-treating large and irregularly shaped forgings, steel castings, shafts, or miscellaneous material packed in pots or boxes, the problems of charging and discharging, and of providing supports to permit the circulation of heat under and around each unit of the charge and to prevent distortion are often the determining factors in selecting furnaces for this class of work. Furnaces of the car type, Fig. 2, and of the car-and-ball type, Fig. 3, are frequently used to meet such conditions. Although each has a movable support for the charge, there is quite a difference in the design of the furnace and the car and in the method of applying and utilizing the heat. Interesting facts relative to these two furnaces have been prepared for publication by the W. S. Rockwell Co., New York City, and some of these are presented in the following:

The selection of the type of furnace and the determination of the size, number and arrangement of the chambers and working openings, fuel, etc., must be governed by the nature and quantity of the work to be heated, the accuracy required in the heat-treating operation, and the plant conditions influencing both the method of heating and of handling.

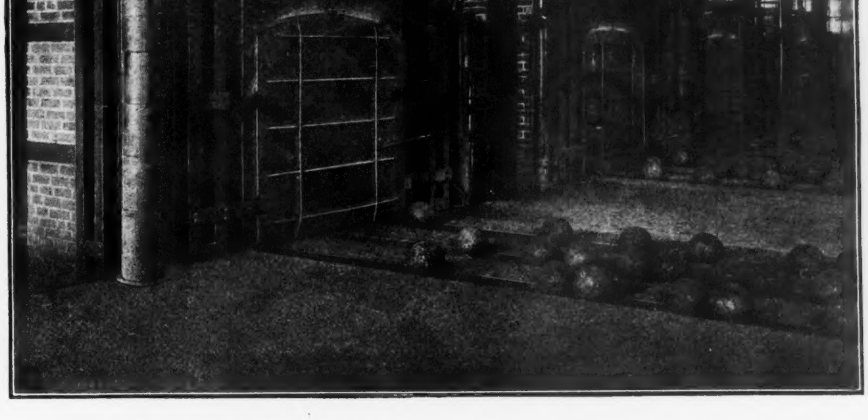


Fig. 1. Front of Car-and-ball Furnaces, showing Balls lying in Runways

Differences in Design of the Two Types

In the car furnace the car itself forms the hearth of the heating chamber, the top alone being exposed to the heat. In the car-and-ball furnace the car rests upon the furnace hearth and is entirely exposed to the heat. The car furnace has well defined limitations in heating, but has certain structural advantages that facilitate the handling of large, heavy, or irregular shaped pieces which cannot be as conveniently handled in other furnaces of better design from the heating standpoint. The car-and-ball furnace, while free from most heating limitations, has certain structural disadvantages which limit the size of the individual car that can be successfully employed.

Car furnaces are generally fired from above the hearth, the upper part of the car, which forms the

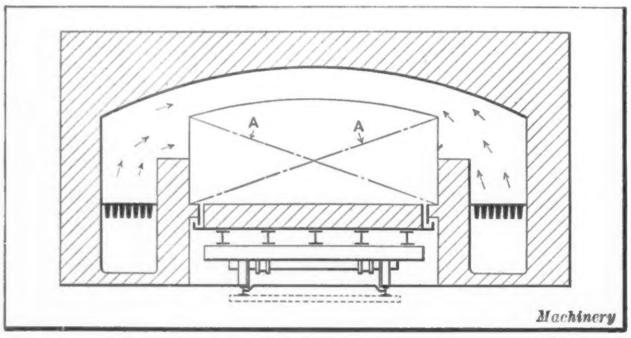


Fig. 2. Diagram showing Typical Construction of an Over-fired Car Furnace

hearth of the heating chamber, being made of refractory material. The lower part is generally made of structural steel and castings, the car being provided with standard car wheels and roller bearings and moving on steel rails. The metal structure is protected from the destructive action of the heat by sand or water seals provided at the sides and end of the car. Provision must be made for the circulation of air under the car to cool the hearth and carry off heat. Car furnaces have been designed with combustion chambers in the body of the car, the heat passing from the chamber through flues in the refractory section. Such a construction, intended to overcome the disadvantages of a comparatively cool hearth, involves structural weaknesses, which, with the factors of expansion and contraction, distortion due to weight of load or abrasion, movement of the car and other conditions, have proved impracticable.

The car in the car-and-ball furnace differs in construction from that in the car furnace in that it is made entirely of metal, being usually cast, and is completely exposed to the heat. The car moves upon balls or rollers operating in runways laid in the floor of the chamber. In Fig. 1 a number of these balls are shown in front of the furnaces. In some cases provision is made to return these balls automatically from one end of the furnace to the other. This type of furnace may be fired from below the hearth as illustrated in Fig. 3. A hotter hearth and a more uniform application of heat to the charge, particularly when the chamber is high, are secured when the furnace is under-fired. Even when the heat is generated above the hearth, which is permissible at times when the charge is comparatively low, a hotter hearth is maintained in the car-and-ball furnace than in the car furnace, because of the passage of the spent gases under the floor and the absence of the comparatively cold zone.

There is a limit to the height of a charge that can be properly heated in the car furnace. This is particularly true in a furnace with a high chamber of the over-fired design as shown in Fig. 4. This design would be warranted if the charge were low and the chamber relatively high and wide, and if the nature and quantity of fuel made the perforated arch desirable. In a furnace of this design there is a necessity for supports to raise the charge materially above the hearth and for having each piece free from contact with any other, so that there may be circulation of heat under and around each of the pieces of the charge. The heating of high charges in the car furnace discloses the undesirable combination of heat originating directly above the top of the charge resting upon the comparatively cold hearth of the car and being forced to the bottom of the charge. Results from actual practice in the annealing of steel packed in moderately high pots show that the tops of the pots are distorted by the heat and the material in this section is overheated, while the material at the bottom of the pots near cold zone X is below the desired temperature.

Area of Exposure in Both Types

Another disadvantage of the car furnace is the unusual area of exposure and consequent cooling of the chamber when the door is raised and the car withdrawn. The top of the car forms the floor of the working opening, which is indicated by lines A, Fig. 2. When the door is raised and the car withdrawn, the actual opening, as shown by dotted lines C, Fig. 5, extends to the level of the tracks. Even though the door be lowered to its normal position, closing the door area, there is still an opening under the door, indicated by lines B, equal to approximately the width of the chamber and the height of the car, as a result of which there is a rapid cooling of the chamber when the car is removed and much discomfort to the workmen. The heat thus lost, which is considerable if the car is withdrawn for a material length of time, must be restored when the car is again moved into the furnace. The alternate heating and cooling is detrimental to the furnace structure.

This disadvantage may be lessened by using a car furnace of the double-end design in which at least two cars should be employed so that a cold car with its charge may be drawn into the chamber as a hot charge is drawn out, one car being loaded or unloaded while the other is in the furnace. In this way, the maximum productive capacity of the furnace is utilized, and there is a saving in time and fuel by the retention of heat in the furnace. In the car-and-ball furnace, the working opening of the chamber may be fully covered when the car is withdrawn, avoiding the ill effects obtained in the car type.

Heat Loss in Cars

In both the car and the car-and-ball furnace there is a loss of the heat given off by the car when a charge is withdrawn. In the car-and-ball furnace there is also an impairment of the car and balls, which does not occur in the car furnace, but this disadvantage is offset by the better heating conditions. When the nature of the material is such as to require accurate heating and to favor the use of the car-and-ball furnace for handling, it is generally found that the gradual deterioration of the car and balls is more than offset by the difference in the quality of the heated product, decreased fuel consumption, increased production, and longer life of furnace structure.

When the nature of the operation is such that the maintenance of the car and balls is difficult, or the size or shape of the car would render it structurally weak under load and heat, the car furnace, even with the disadvantages referred to, may be preferable, provided, however, that the charge is sufficiently low and the chamber relatively high

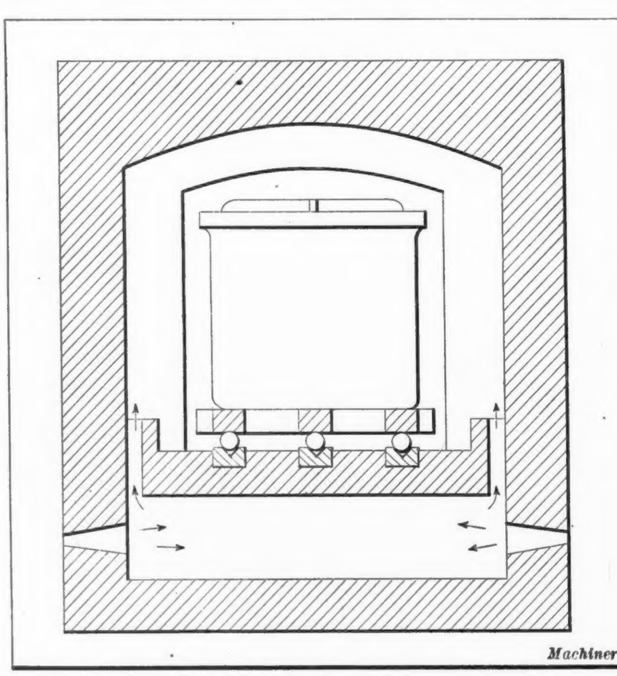


Fig. 3. Under-fired Car-and-ball Furnace in which the Car is entirely exposed to the Heat

and wide to prevent unequal heating of the upper and lower sections of the charge. Whenever the car furnace is used, provision should be made to raise the charge above the car and keep each piece free from contact with the car or other pieces, to insure the circulation of heat throughout the charge.

Heating and Cooling of the Charge

When the operation is a heat-treatment involving quenching or quick cooling after heating, it is difficult to quench or cool each piece in the same manner from either type of furnace. This is particularly true when the charge consists of a number of pieces to be quenched individually. In such cases the pieces must be removed from the car rapidly to offset the difference in rate of cooling due to the difference in the time of exposure to the atmosphere between the first and last piece removed from the car. When the charge to be heated and quenched consists of a number of large pieces, it is frequently desirable to handle the pieces on individual carriages in a car-and-ball furnace. Each piece may then be withdrawn separately from the chamber, with the assurance that it has received the same rate of exposure in heating and cooling. In some works the major part of the heated product may be handled in a car-and-ball furnace, but there may be a quantity of very large irregular shaped pieces which cannot be handled well in any other than a car furnace. In such cases the car furnace is usually selected for convenience in handling the large pieces, and on the assumption that care will be taken to so place the individual pieces on the car that each will be subjected to the heat in the same manner.

Side Opening Furnace

A novel application of the car-and-ball furnace principle, made to meet manufacturing requirements covering the heat-treatment of a variety of large and heavy material, is shown by the side-opening furnace in the heading illustration. This furnace has a chamber which may be divided by movable partition walls into a number of sections, each of which may be heated separately or, after removing the partitions, in conjunction with any or all of the others,

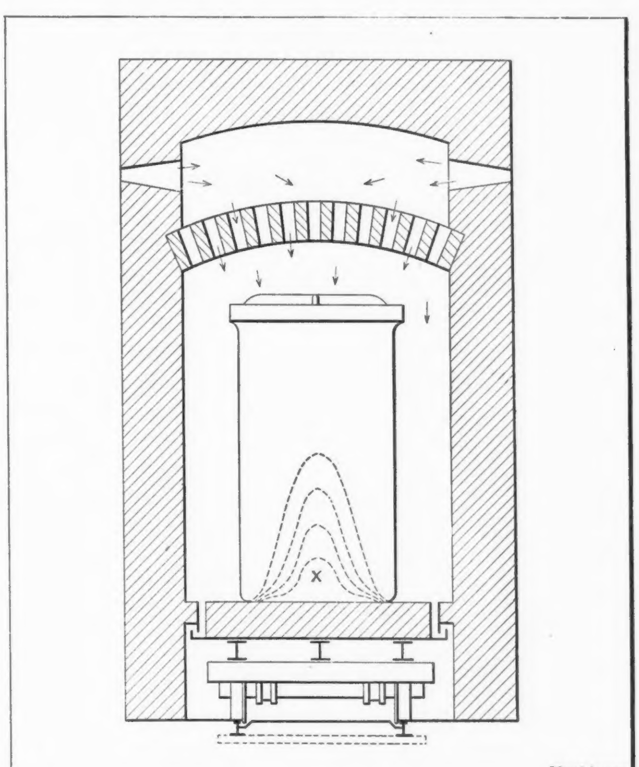


Fig. 4. Design of Car Furnace Likely to produce a Cold Zone at Bottom of Charge

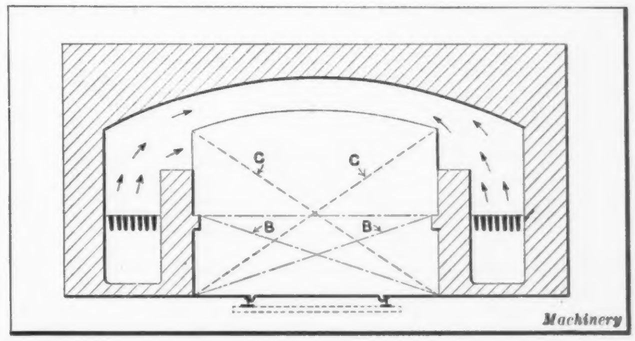


Fig. 5. Relative Area of Exposure with Car in and out of Furnace

thus making possible the heating of pieces ranging from small die-blocks to shafts 100 feet long. The doors covering the working opening are dovetailed and prevent the entrance of cold air or the escape of hot gases. These doors may be raised or lowered independently of one another and are operated by counterweights and pneumatic hoists.

The doors are practically balanced by the counterweights, so that very little air is required for their operation. Valves for controlling the individual doors are located at the side of the furnace. The flat roof of the furnace is constructed of tiles, supported by an overhead cantilever construction. Locating the combustion chambers under the hearth insures a hot bottom and the best of heating conditions. To insure proper circulation, part of the gases in the heating chambers are drawn back into the combustion chambers and again circulated through both chambers. The spent gases, which are drawn off below the heating chamber, pass to the top of the furnace and circulate around preheaters. The air passing through these preheaters serves the burners and thus returns to the combustion chambers a material portion of the heat in the spent gases that would otherwise be lost.

Fuels for Car and Car-and-ball Furnaces

Both car and car-and-ball furnaces have been successfully operated for years with coal, gas, and oil fuel. The number and position of combustion chambers or fire-boxes, flues, etc., must be determined by the size of the furnace and the manufacturing conditions governing the operation, which likewise control the selection of the fuel. Car-and-ball furnaces of under-fired design, using coal fuel, show better results in uniformity of operation and cost for high-grade product than car furnaces using oil or gas fuel for a similar product. This is accounted for by the difference in the method of applying and utilizing the heat and not by the nature of the fuel itself. The fuel, like the type of furnace, must be selected with regard to the requirements of the individual case.

Sizes of Furnaces

Owing to the great variety of shop conditions and the many combinations possible with different arrangements of chambers, working openings, kinds of fuel, etc., it is impracticable to standardize these furnaces. Car furnaces have been built in widths up to 12 feet and in lengths of over 100 feet. They have also been made with chambers 30 or 36 inches in width, but as a general rule it is not good practice to build car furnaces in such small sizes, when the material can be conveniently handled in any other type of furnace that will afford better heating conditions. Car-and-ball furnaces may be employed to advantage in relatively smaller sizes, though the maximum length and width should be governed by the structural features of the all-metal car. Although large individual cars may be employed when the temperature is comparatively low, it is the usual practice to employ a number of cars when the requirements of temperature and the size of the charge make the large car impracticable.

The Machine Tool Situation in Scandinavia

By C. E. SIMON, Sales Manager, Swedish Machine Tool Makers Export Co., Ltd., Stockholm, Sweden

IN Scandinavia, as elsewhere, the market is entirely stagnant and there are no signs of recovery so far, although both wages and prices of raw materials have been somewhat reduced. Most of the machine tool factories are working part time only, and have large stocks on hand. There is, of course, no market for imported machine tools. Swedish firms are hoping much, however, from the Bolshevik commission in Stockholm, which is stated to have instructions for purchasing large quantities of Swedish machine tools. Furthermore, as has been mentioned previously in MACHINERY, this commission has already placed large orders for locomotives, their method of procedure being to buy the producing firm outright. This, however, has to be done through a third party, it being illegal under Swedish law for any alien to own more than a fifth of the shares in a Swedish company.

Future Market for American Machine Tools

In Denmark medium and cheaper grades of machines are principally sold; in the latter class the proximity of the German manufacturers makes competition practically impossible under present conditions of exchange, so that the best prospects would appear to be for a medium class of tools. The prices of Danish-built lathes are approximately as follows: Light gap lathe, 12 inches swing (cheaper grade), $400; gap lathe, 16 inches swing (medium grade, weight 1 ton), $900. The Danish exchange has been fluctuating considerably recently, but the foregoing is reckoned on a rate of 5.50 Danish krona = $1.

German tools are offered at about half these prices, but owing to frequent disappointments as to deliveries and variations between contract prices and prices at which machines are eventually delivered, the German sellers do not have as much success as might be expected.

Norway is not a manufacturing country and the market is a small one. Prices ruling there are about the same as in Denmark. In both countries, Swedish-made machines have an excellent reputation, and in ordinary times sell at prices equal to those of American machine tools.

Sweden probably offers the best chances for high-grade machine tools. Up-to-date machines are purchased even by the smaller shops, as is evidenced by the fact that the large machine tool factories in Sweden turn out as many all-geared lathes as cone-driven ones. The machines made locally are in very high repute and in the cases of lathes, milling machines—both plain and universal—and presses, competition will probably always be difficult, while in shapers it is impossible. Automatics and high-production machines are not fully appreciated yet, but there is certainly a market for that class of machines, while the chances for radial, upright and sensitive drilling machines, screw machines, the larger grinding machines and hack-saws, none of which are manufactured to any extent here, should be good when business becomes more normal. Bolt and nut making machinery is produced by only one firm, and its deliveries are slow.

Present Prices of Machine Tools in Sweden

Owing to the high cost and difficulty of working Swedish cast iron, the cost of locally made planers is rather high, $3300 being the cost of a machine to plane 32 inches by 32 inches by 8 feet. There should consequently be a market for a medium grade machine of this type. Machine tool prices ruling at present are as follows: 16-inch shaper, high grade, $775; light 16-inch shaper, cheaper grade, $400; light high-grade quick-change gap lathe, 12 inches swing, $500; cheaper grade (splined lead-screw) $375; high-grade quick-change all-geared lathe, 16 inches swing, $1500; cheaper grade cone-driven gap lathe, $900. The above prices are to the user and are calculated on an exchange rate of 4.50 Swedish krona = $1.

Owing to the exceptional exchange conditions, a number of German machines have been imported into Sweden since the war, but before the war they were not at all popular and only the best German machines found a market. American small tools and grinding wheels are very well known and always find a ready market.

Lathes should have English System Lead-screws

A mistake sometimes made by American manufacturers is to send lathes fitted with metric lead-screws to the Scandinavian countries. Although the metric system is in general use, Whitworth pitches are used for all screws. Another error consists in bracketing the three countries together and appointing one selling agent for all. It is true that one important machine tool dealer has offices in the three capitals, but with this exception separate agents should be appointed, as it is impossible for an agent in any one of the three countries to get good results from the other two.

Trade with Finland through Sweden

Although geographically Finland does not come within the scope of this article, actually the connection between that country and Sweden is much closer than between any two of the Scandinavian countries, nearly half the population—including practically the whole business community—being of Swedish extraction and speaking Swedish in preference to Finnish. In ordinary times much of the buying is done through Stockholm, and, needless to say, Swedish machine tools are much in demand. At the present moment the Finnish rate of exchange, which is rather worse than that of Italy, has made the purchase of Swedish and American tools equally impossible.

Large quantities of woodworking machines are used in Sweden and in Norway, but it is not likely that there would be much of an opening here for American competition, as there are so many excellent machines turned out in Sweden.

Scandinavia as a Competitor in Other European Markets

Prior to the war Sweden had an important export trade in machine tools and small tools, but most of these exports were absorbed by Russia. The war caused a considerable extension in the production of the various machine tool factories, together with the adoption of improved methods of manufacture. To make the most of post-war opportunities Svenska Verktygsmaskinfabrikers Export A. B. (Swedish Machine Tool Makers Export Co., Ltd.) was formed in 1917 by a number of the most important Swedish machine tool manufacturers. This firm was to act as a non-profit-making sales department for the firms of which it was composed. At the same time, by limiting each factory to the manufacture of certain types of machine tools in which it could specialize, increased production and improvement in design were expected.

The firms now forming part of this organization are A. B. Atlas Diesel, A. B. Karlstads Mekaniska Verkstad, Köpings Mekaniska Verkstads A. B., A. B. Lidköpings Mekaniska

Verkstad, Munktells Mekaniska Verkstads A. B., Nydqvist & Holm A/B., and A. B. Svenska Maskinverken. With their own branch office in Brussels and agencies in most European countries, a great deal has been done toward making these machines known. With the exception of the last three months of last year, when the general trade depression in Europe began to make itself felt in the decreased purchasing capacity of machine tool buyers, the results showed that it was not impossible to compete successfully with the better known American tools. There are a number of outside firms doing a certain amount of export trade too, but with two or three exceptions these are competing in a cheaper class. Denmark has a considerable export trade in a medium class of machine tools, principally lathes.

Special machinery of various kinds is also exported to a certain extent from Scandinavia, namely paper-making machines, match-making machines, cigarette-rolling machines, sardine-tin making machines and horseshoe machinery. Swedish small tools are also finding a ready market; particularly is this the case with saws and saw blades, the high quality of the Swedish steel making it possible to sell these despite their high price. Other items in this line are drills, taps and dies, reamers, etc. The names of Bolinders, Beronius, Jonsered and Westmann are known throughout Europe for woodworking machinery and cutters. Sweden is fully alive to the possibilities of the European market for the export of machinery of all kinds, and its competition in these markets is likely to be of increasing importance.

* * *

STANDARD PIPE THREADS

By EARLE BUCKINGHAM
Engineer, Pratt & Whitney Co., Hartford, Conn.

The machine shop is frequently called upon to cut threads on standard pipe. As pipe threading is a distinct specialty, and the majority of this class of work is handled by shops making a specialty of this work, men in the machine shop are seldom as familiar with the various standard pipe threads as they are with other more commonly used standards. A synopsis of the character and uses of the various pipe thread standards should therefore be of interest.

American Standard Taper Pipe Thread

The American standard taper pipe thread was formerly known as the American Briggs standard. The form of the thread is a 60-degree vee, truncated equally top and bottom by an amount equal to 0.033 times the pitch of the thread. The taper of the thread, on the diameter, is 1/16 inch per inch or ¾ inch per foot. As far as the thread on the product is concerned, no change has been made from the former American Briggs standard; but to allow for a reasonable amount of wear on the taps and dies, thus making for more economical production, a modification has been made on the gages. This consists of reducing the crest of the thread gage by truncating it an amount equal to 0.10 times the pitch from the theoretical sharp point. If an old gage is correct in all other respects, it can easily be made to conform to the present standards by grinding off the excess metal at the crests of the threads. Full information in regard to the American standard taper pipe threads will be found in Bulletin No. 1733, "Manual on American Standard Pipe Threads," published by the American Society of Mechanical Engineers. This taper thread can be used for threaded joints for any service.

American Straight Pipe Thread

Straight-threaded female wrought-iron or wrought-steel couplings of the weight known as "standard" may be used with *taper-threaded* pipe for ordinary pressures, as they are sufficiently ductile to adjust themselves to the taper male thread when properly screwed together. For high pressures, only taper male and female threads should be used. The use of this straight thread for male parts is only recognized for one or two very special applications, which are seldom, if ever, required in ordinary machine shop practice.

The form of the American straight pipe thread is identical with that of the American standard taper pipe thread. The gage to be used to check a straight threaded hole is the standard taper thread plug gage which is used to inspect the American standard taper pipe thread. Full information about this thread standard will be found in the A.S.M.E. Bulletin No. 1733, previously mentioned.

Lock-nut Thread

The lock-nut thread is a straight thread of the largest diameter which can be cut on a pipe. Its form is identical with that of the American standard taper pipe thread. In general, "Go" gages only are required. These consist of a straight-threaded plug representing the minimum female lock-nut thread, and a straight-threaded ring representing the maximum male lock-nut thread. This thread is used only to hold parts together, or to retain a collar on the pipe. It is never used where a tight threaded joint is required. Full information about this thread standard will be found in the bulletin previously mentioned.

Special Straight-fixture Pipe Thread

The special straight-fixture pipe thread consists of a straight thread of the same pitches as the American standard pipe thread, but having the U. S. form. This thread, as its name implies, is used for fixture work to hold parts together, but not to make tight threaded joints. The male thread is assembled with a standard taper female thread, while the female thread is assembled with a standard taper male thread. This thread is used on lighting fixtures and work of a similar class when it is desired to have the joint "make up," or stop, on the thread. The gages used are straight-threaded limit gages. Full information about this thread standard will be found in Bulletin No. 1525, "Report of the Committee on Standardization of Special Threads for Fixtures and Fittings," published by the American Society of Mechanical Engineers.

Special Straight Electric Fixture Thread

The special straight electric fixture thread consists of a straight thread of the same pitches as the American standard pipe thread, but having the U. S. form, and is used for caps, etc. The male thread is smaller, and the female thread is larger than those of the special straight-fixture pipe threads. The male thread assembles with a standard taper female thread, while the female thread assembles with a standard taper male thread. This thread is used when it is desired to have the joint "make up" on a shoulder. The gages used are straight-threaded limit gages. Full information about this thread standard will be found in the A.S.M.E. Bulletin No. 1525, previously mentioned.

It will be noted that each of the five different pipe thread standards has a specific name and purpose. If the proper thread is selected, and all taps, dies, gages, etc., are ordered from any maker of small tools and gages by this name, many delays and much confusion will be eliminated.

* * *

A 135-YEAR-OLD BRITISH ENGINE

To the recently published records of the remarkably long life of early British steam engines there should be added the case of an engine which has been in active service for 135 years. This was a pumping engine made by James Watt himself, the inventor of the original condensing steam engine. It was used for pumping a dry dock on the Clyde, and was removed a short time ago because of the closing up of the particular harbor where it was at work. It is stated that it will be placed in a museum.

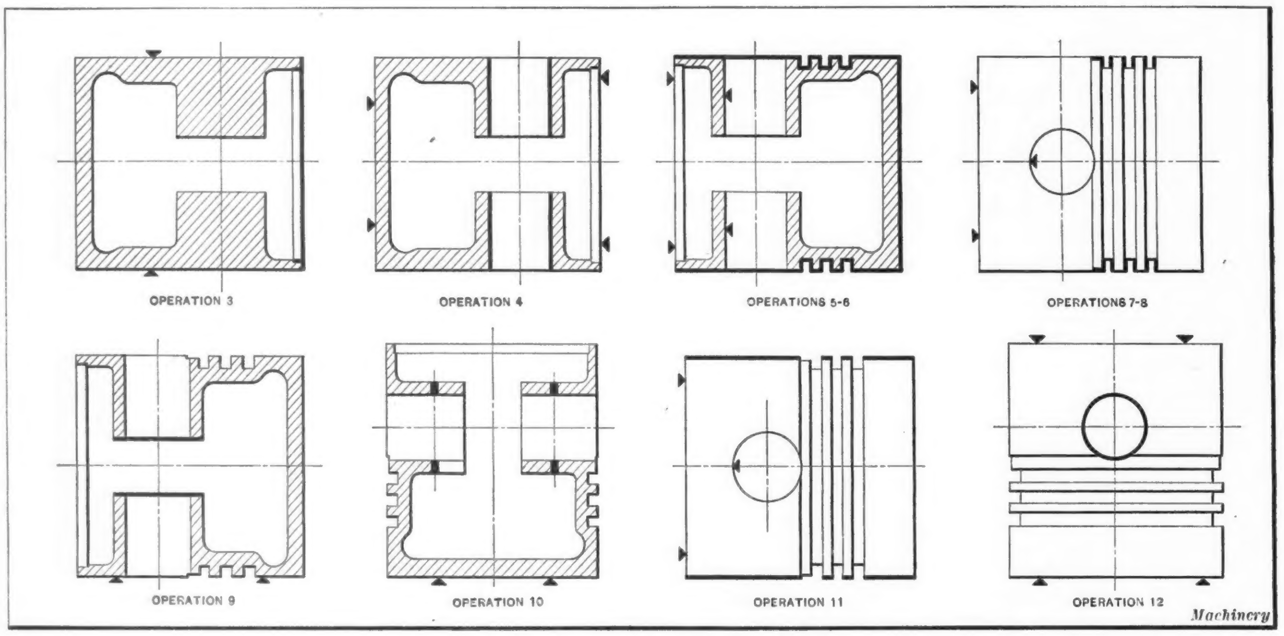


Fig. 1. Order of Machining Operations on Motor Piston

Machining Motor Pistons

Successive Steps and Equipment Employed in Machining Pistons for a High-grade Automobile

By C. H. DENGLER

THE illustration Fig. 1 indicates clearly the various machining operations required in the production of an aluminum piston for the motor of one of the highest priced automobiles made in this country. Like most cars of this class the production is comparatively limited; hence, the methods and tools used in its manufacture vary somewhat from those customarily employed in plants equipped for higher production rates. The first operation performed on the piston, after it is received from the foundry in the form of a rough casting, is that of cleaning. In the second operation the piston is annealed by either of two methods, one of which is to boil it in an oil bath at a temperature of about 300 degrees F. The other method consists of heating the piston in a furnace to a temperature of 800 degrees F., and then allowing it to cool in air. As the first method has proved detrimental to the health of the operators, the second is generally used.

In the third operation the piston is chucked on the outside diameter, and the open end is faced and bored on the surfaces indicated by the heavy black lines in Fig. 1. These finished surfaces are used in locating the work for all subsequent machining operations. As standard tools are used for this operation, no description is necessary. The next or fourth operation is drilling, boring, and reaming the

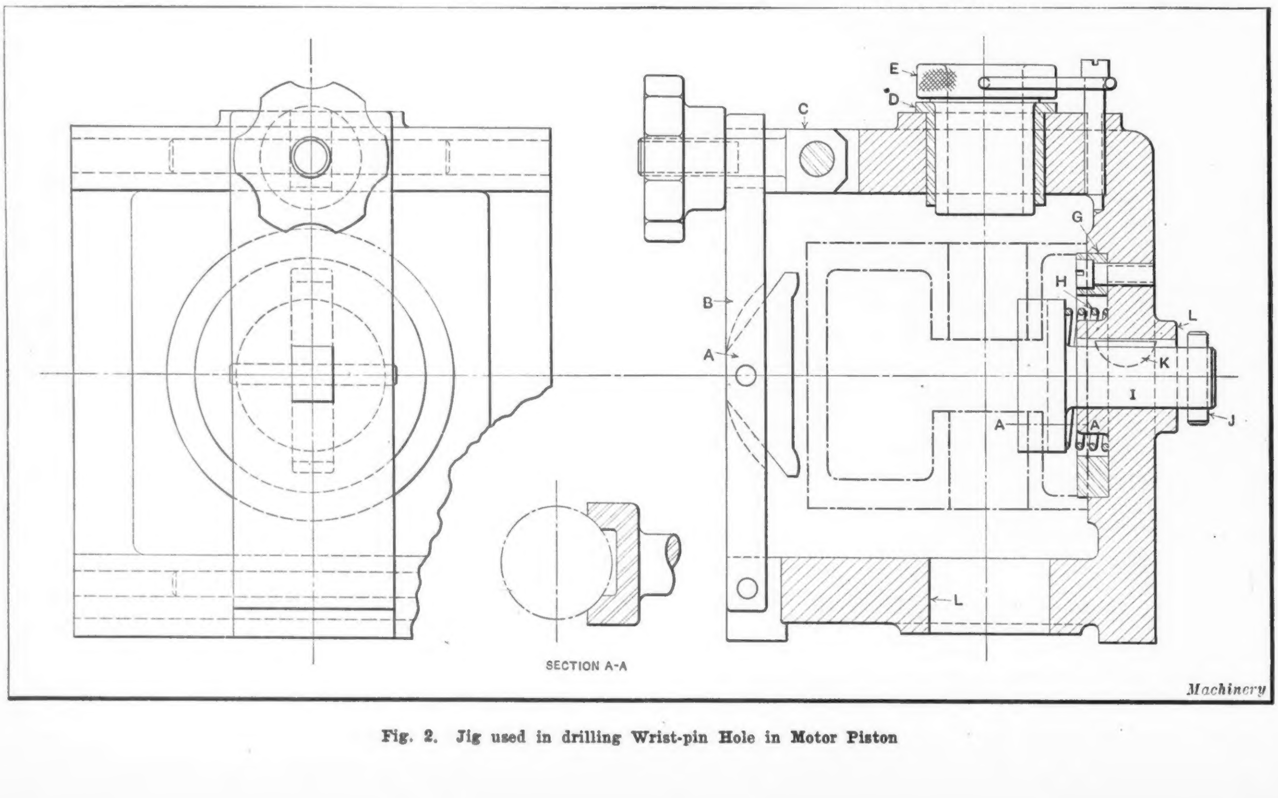


Fig. 2. Jig used in drilling Wrist-pin Hole in Motor Piston

wrist-pin hole to within a few thousandths inch of the finished size. Different methods are used for performing this operation by various companies, but the writer has always obtained the best results with a drilling machine and a suitable drill jig, especially when the work is being done in a small shop.

The jig used in this case is of rugged construction, and is so designed that it will handle work very rapidly. Referring to Fig. 2, it will be noticed that ring *G* centers the piston under the drill bushing *E*, while the sliding V-block *I*

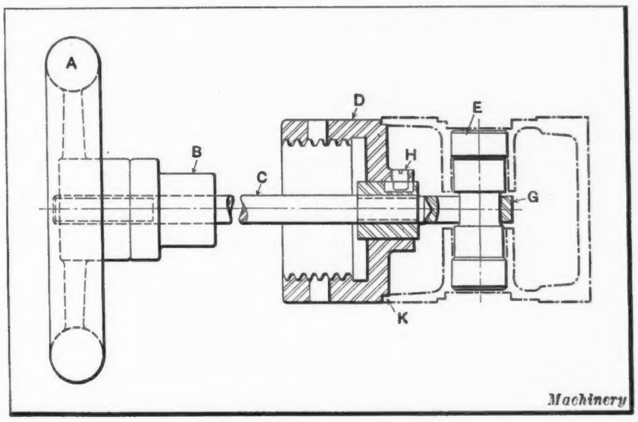


Fig. 3. Chuck used in holding Piston for Turning and Grooving Operations

serves to bring the bosses of the piston-pin hole into alignment with the center of bushing *E*. V-block *I* is normally held forward by spring *H*, so that pin *J* is in contact with boss *L*. The vee is kept parallel with the drill bushing by means of key *K*. The piston is held in place by the hinge clamp *B*, which is provided with an equalizing arm *A*, eyebolt *C* being employed to tighten the clamp on the work.

In the fifth operation the outside diameter is turned to within a few thousandths of the finish size, and in the sixth operation, the end is faced and the ring grooves roughed out. While performing these operations, the piston is held in a chuck, shown in Fig. 3, which is mounted on a lathe spindle. Although this chuck is of simple construction, it has proved very satisfactory. As shown in the illustration, the nose-piece *D* is threaded to fit the end of the lathe spindle. The piston is located so as to be concentric with the lathe spindle by the accurately turned shoulder at *K*, and is clamped to this shoulder by means of pin *E* and draw-rod *C*, actuated by handwheel *A*. The draw-rod is provided with an eye *G* in which pin *E* is held. Screw *H* prevents eye *G* from turning when the handwheel is tightened. Pin *E* is relieved so that it bears only at the outer ends, in order to eliminate distortion as much as possible.

This chuck is also used while performing the seventh and eighth operations, in which the piston is finish-grooved, and the relief is cut for the lower ring, respectively. The ninth operation consists of facing the inside of the piston bosses with a double-faced cutter, which is used in a drilling machine. A simple plate jig, fitted into the open end of the piston is used when drilling the two oil-holes as indicated, in the tenth operation. In this operation location of the oil-holes is obtained by two pins which project from the under side of the jig plate and straddle one of the bosses.

The last two operations finish the bearing surfaces of the piston so that they are brought to size. Any tool marks or blemishes due to handling are also removed at this time. The chuck shown in Fig. 3 is also employed for holding the piston while performing the eleventh or finish-turning operation. In this operation a taper-turning attachment on the lathe is used to finish the outside of the piston to size. By giving the piston a slight taper to obtain the variation in diameter required to compensate for unequal expansion, etc., the customary method of step-turning is avoided.

The twelfth operation consists of hand-reaming the wrist-pin hole to size, using the jig shown in Fig. 2, which was employed for the rough-drilling operation as previously described. Two slip bushings and a piloted double-end reamer are employed for this operation in connection with the jig. A final inspection is given the pistons when they are arranged in sets for assembling in the motors. This inspection includes balancing each set of pistons carefully so that the running or dynamic balance of the engine will be as nearly perfect as possible.

* * *

CONCRETE HOUSES FOR INDUSTRIAL WORKERS

The Ingersoll-Rand Co. has undertaken a building project in order that the employes of its factory at Phillipsburg, N. J., may obtain by rental, or by purchase on easy terms, desirable homes. These houses are made in concrete forms, and care has been taken in making these forms so that they can be used over and over again. The forms are creosoted and painted to preserve them, and oiled and cleaned each time before using.

All the concrete work of the roof, walls, partitions, and under floors is poured in special forms. By this method, a group of houses can be erected by continuous repetition of certain sets of operations, permitting the greatest possible economy in erection. The pouring operation can be completed in from 8 to 11 hours, and the forms can be removed and set up on another foundation in from four to six days after the pouring is completed. The window sashes and door frames, flue lining for the chimney, plumbing, and electric light conduits are placed before the walls are poured. When a certain stage of erection is reached, the conduits and pipes, all of which are alike and fitted in advance, are quickly set in place.

The houses are of four- and six-room size. A four-room house with basement and a 40 by 100 foot lot rents to employes at $16 a month, and may be bought for $2750 on a liberal payment plan. The six-room concrete houses rent

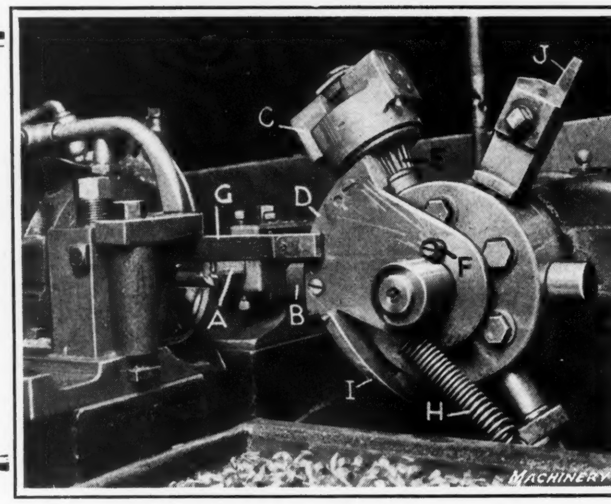
Six-room House erected for Employes by the Ingersoll-Rand Co.

for $18, and sell for about $3000. No cash is required at the time of purchase, and the total payments may be as low as $22.44 a month.

These houses are known as the Ingersoll type, on account of the fact that Charles Ingersoll, who has been greatly interested in housing projects for a number of years, is largely responsible for this particular type of construction. The forms for the concrete are covered by a patent controlled by Mr. Ingersoll and his associates.

Machining a Grooved and Tapered Part

By ELMER P. SACREY



IN the manufacture of the double-grooved and tapered brass part illustrated at *A*, Fig. 1, five distinct operations were originally employed. The part is the spiral center of a mist nozzle used for conditioning the air in meat packing houses, and the specifications require that the two grooves be of such a size that when the part is assembled in the nozzle one gallon of water (within about three or four ounces) can be forced at a certain pressure through the grooves in thirty seconds. An idea of the size and shape of the grooves may be obtained by reference to the illustration of the groove-cutting tool, which is shown at *B*. The distance between the bottoms of the two grooves is the same for the entire length of the part.

In the method formerly used, this spiral center was machined from a casting, the five operations being performed in the following succession: (1) The part was turned, faced, and cut off from its supporting end in a hand screw machine. (2) The two grooves were produced on a hand milling machine provided with a special fixture for holding the work. (3) The burrs on the face of the small end were removed on a grinding machine. (4) The burrs on the tapered surface were removed by means of a tool mounted in a drilling machine. (5) A lot number was stamped on the front of the small end in a foot press. The rate of production from this method was unsatisfactory, and so many of the parts were rejected because the grooves were improperly milled, due to the work slipping in the chuck of the milling machine, that the concern was undergoing a considerable loss on the contract. Subsequently, an attachment was designed whereby the part could be produced on a Brown & Sharpe automatic screw machine from 9/16-inch diameter, commercial brass bar stock.

This attachment is shown in the heading illustration, mounted on the turret of the machine and with the various tools in place. It will be seen that the stock extending from the chuck was tapered and grooved at the time that the photograph was taken, and so the next operation consists of cutting off the completed part and turning the tapered surface on the portion of the stock which will form the next part. This operation is accomplished by the forming tool *A*, which is mounted on the rear cross-slide of the machine. After tool *A* has been withdrawn from the work, the stock is fed up against stop *B* which is mounted in the turret. Raised numerals corresponding to the lot number of the part are provided on the front of stop *B*, and the impact of the stock against the stop is such that the number is reproduced on the front of the work. The turret is then withdrawn from the work, after which it revolves until the milling head *C* is brought into the operating position. This head carries two cutters of the dimensions shown at *B*, Fig. 1, for cutting the grooves; the manner in which the cutters are rotated will be described in detail later. As head *C* is advanced over the work, it is also rotated slowly, so that the two grooves will be helical.

This rotary movement is obtained through a bevel gear segment on the back of plate *D* meshing with the bevel pinion *E* which is screwed into the milling head. Thus, when roller *F* comes in contact with bar *G* as the milling head is advanced toward the work, plate *D* is swiveled on its axis, and the bevel segment causes pinion *E*, and the milling head, to be rotated an amount depending on the movement of roller *F*. The milling head is provided with a hardened bushing which slips over the work and supports the latter while the grooves are being machined. Withdrawal of the milling head from the work is accomplished at four times the rate of the advancing speed, and in this step the groove cutters are caused to follow the grooves just milled, by roller *F* being held against bar *G* through the action of the coil springs *H*. Because of the limited amount of space in which the turret revolves it was impossible to use one spring of large diameter and so, in order to secure sufficient tension on plate *D*, it was necessary to use two springs, one being placed inside the other. The two springs are of opposite hand to avoid tangling, and the outer ends are secured to a bracket held in a hole of the turret. It will be evident that the returning movement of plate *D* is ended by the plate coming in contact with a stationary plate *I*, which is also mounted in one of the turret holes.

When the milling head has been withdrawn from the work, the forming tool *A* is again fed forward, cutting off the finished part and tapering the portion of the stock which is to be grooved next. While this operation is being performed, however, tool *J* is brought into position and fed forward, cutting all burrs from the work. By the time that the operation performed by tool *A* has been completed, the turret has again been revolved until stop *B* is in the position illustrated. A plug is placed in the turret hole between tool *J* and the bracket to which coil springs *H* are secured, so that the turret can be kept filled with oil. By the use of this set-up, the average time for machining one part is only fifty-one seconds.

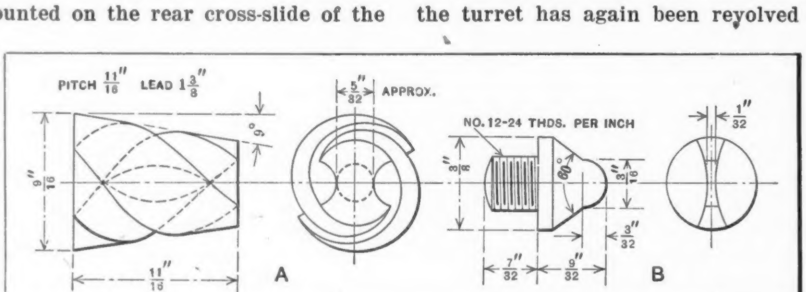


Fig. 1. (A) Spiral Center for Mist Nozzle. (B) Dimensions of Cutters used to produce the Grooves on the Spiral Center

A sectional view of the milling head is shown in Fig. 2, in which bevel pinion *E* corresponds to that in the heading illustration having the same reference letter. This pinion is a running fit on shaft *A* and on the hub of gear *B*, and so is not affected by their rotation. Shaft *A* extends into the turret and is connected through bevel gearing to a horizontal shaft running through the hollow spindle of the turret-slide. The horizontal shaft is driven by a grooved pulley at the back of the slide, which is connected by a round belt to a similar pulley on the countershaft. This belt can be seen in the heading illustration. Referring again to Fig. 2, it will be seen that shaft *A* is screwed into bevel gear *B*, and by this arrangement bevel pinions *C* and *D* are driven when shaft *A* is rotated. These pinions are mounted on opposed spindles to which cutters *F* are attached, and so the latter are rotated with the pinions. Cutters *F* are of the dimensions shown at *B*, Fig. 1. Each cutter-spindle is provided with two ball races. The speed of these spindles is approximately 3600 revolutions per minute. The cutters are made from drill rod, and are hardened and ground. From 2500 to 3000 spiral centers are produced, on an average, before it becomes necessary for a set of cutters to be reground.

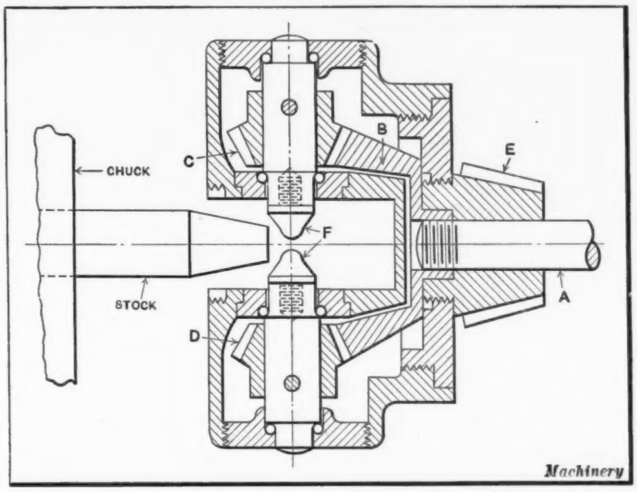


Fig. 2. Sectional View of Milling Head showing Method of driving the Grooving Cutters

* * *

USES OF INVAR

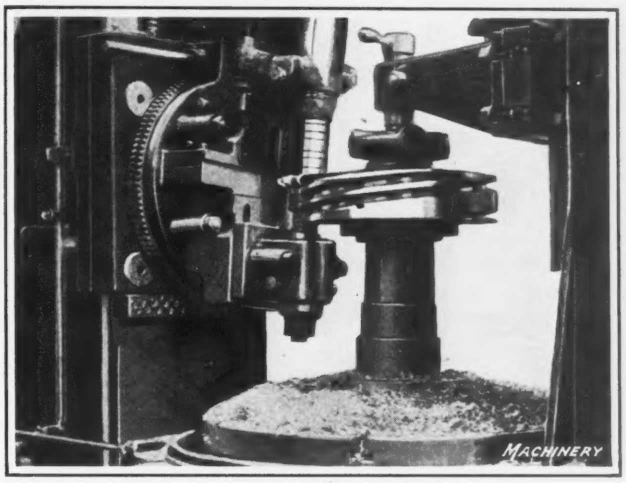
Invar, which is an alloy of steel and nickel in which the latter metal enters to the extent of about 35.6 per cent, has proved its value particularly for measuring tapes and precision measuring means. The characteristic which makes this alloy especially adapted for such uses is its low coefficient of linear expansion, which is 0.00000119. It will be readily apparent that the employment of measuring wires made of invar, which have scarcely any change in length with the changes of temperature, greatly facilitates the accurate determination of lengths on the earth's surface. By employing measuring wires made of this material the number of requisite observers is reduced to one-fifth the number previously required, the time expended is only one-tenth as much, while the expense falls to 2 per cent of the former amount. It is also possible to work on terrain where the older type of apparatus cannot be set up.

Additional applications of this nickel-steel alloy are as follows: (1) For compensating the pendulums of clocks for temperature changes. (2) For improving the time-keeping qualities of watches; where the balance wheel is made of only one metal, a nickel-steel spring keeps the daily loss or gain very small. (3) For the mountings of glass and for leading-in wires to incandescent lamps; an alloy for these purposes is selected which has the same expansion coefficient as the glass with which it is to be used. (4) For measuring standards.

THREAD MILLING ON A HOBBING MACHINE

The cutting of medium and small diameter worms of single thread presents no difficulty to the average shop, as they can readily be cut on a lathe. The cutting of ordinary multiple-thread worms is a more troublesome proposition unless the operation can be performed on a thread milling machine. However, the machining of multiple-thread worms of large diameters is usually difficult for the average shop. If the pitch is small, the worm can sometimes be cut on a plain milling machine provided with a universal milling attachment for the cutter-head and a spiral dividing head for the work, but this arrangement is not sufficiently rigid for heavy work. The illustration shows a hobbing machine built by the Newark Gear Cutting Machine Co., Newark, N. J., which is primarily intended for cutting teeth on spiral and worm gears, cutting a quadruple thread worm of 14.406 inches pitch diameter and 1 1/8 inches linear pitch, by the use of a formed disk milling cutter.

The reason for cutting the worm in this manner was that no hob of this unusual pitch was available. The gearing of the hobbing machine was arranged the same as though a hob was being used instead of the formed disk milling cutter, it being necessary to connect the hand indexing attachment. Only one cut was required for each thread, and after a cut had been taken, the work was moved a trifle away from the cutter to prevent scoring when the cutter-head was raised. By using the rapid traverse of the head, the proper relation between the cutter and the threads was maintained. After the cutter had been raised upon the completion of a cut, the work was properly indexed by hand for milling the next thread. The worm was made of a hard phosphor-bronze, and was cut in 3 1/2 hours by using a carbon steel cutter. A high-speed steel cutter of the desired size was not at hand, but if such a cutter had been available, the operation could probably have been performed in about two hours.



Hobbing Machine set up for milling a Quadruple Thread Worm of 1 1/8 Inches Pitch

* * *

TARIFF ON CATALOGUES IN BRAZIL

According to *Commerce Reports*, ordinary circulars or catalogues sent into Brazil are subject to a duty of 150 reis per kilogram, 45 per cent of the amount being payable in paper and 55 per cent in gold. As gold is now valued at approximately three times the equivalent of paper money, the duty will amount to about 3.2 cents per pound. This applies to catalogues sent in bulk, it being stated that when the duty on a single package of printed matter is small, the goods are delivered immediately without duty being levied. Catalogues that are highly illustrated are subject to a still higher rate of duty, amounting to as much as 32 cents per pound.

Formulas for Spring Design

By EDWARD JACOBI, Chief Engineer, Briggs & Stratton Co., Milwaukee, Wis.

WHEN a spring is required for use in a machine or mechanical device, the greatest pressure it is to exert is seldom known or specified, but nevertheless the designer realizes that it should have certain characteristics that may be termed "feel," for which he cannot easily give dimensions. Accordingly he allows the spring whatever space in his judgment is permitted by the design. When the machine or device is built, trial springs are wound and tested until one is produced which operates satisfactorily. Before this is accomplished, however, it is often found necessary to provide more space for the spring than was first allotted. The formulas given in this article were worked out by the writer to provide a means whereby designers and draftsmen could determine mathematically, the size of wire and the number of coils a spring should have to meet any given requirement, and thus eliminate the lengthy experimental process.

When a spring is extended or compressed, the pressure naturally increases until the end of the stroke is reached. In most cases, however, it is desired that the spring exert as nearly uniform a pressure as possible throughout the stroke, and at the same time maintain its strength through a long period of service. In addition to this, the spring is usually required to exert as great a pressure as can be obtained in the space in which it is required to operate. Stated in another way, the size of wire and number of coils should be so chosen that the greatest possible pressure is exerted at the beginning of the working stroke, and at the same time sufficient flexibility is retained to permit the specified deflection to the end of the stroke without taking a permanent set. This is the condition usually met with in designing various kinds of springs for detents, catches, clips, electric switch contact points, and whatever hand- or foot-operated members are to be returned to their normal positions by springs.

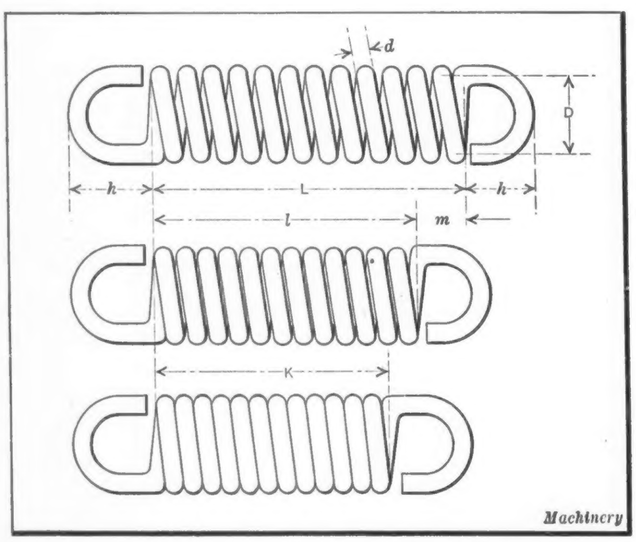


Fig. 1. Application of Formulas for Extension Spring Design

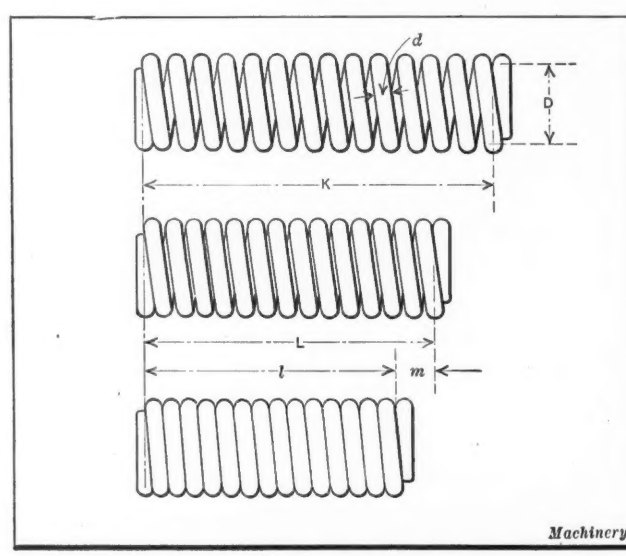


Fig. 2. Application of Formulas for Compression Spring Design

Designing Extension Springs

First let the design of extension springs of limited diameter and length which are wound without initial tension be considered. The hooks at the ends of the springs, which are rigid and contribute nothing to the flexibility, should be disregarded. The strength of the spring can, of course, be increased by using thicker wire, but when this is done fewer turns can be wound in a given length, and if the wire is too thick, the spring will not be sufficiently flexible for the required movement. Referring to Fig. 1, L equals the length of the working part of the spring when fully extended. This is the space allowed for the spring less the lengths h of the hooks. The length l represents the length of the working part of the spring in its initial position or at the beginning of its stroke. Therefore, the working length m of the spring equals $L - l$. The diameter of the wire from which the spring is made is represented by d. The mean diameter D of the spring equals the outside diameter of the coils minus the diameter d of the wire. S equals the working shearing strength of the wire, and E equals the torsional modulus of elasticity. Then under the given conditions of spring space and working range, the maximum pressure at length l will be attained when

$$d = D\sqrt{\frac{3l\pi S}{5Em}}$$

After d has been found, it may be substituted in the strength and deflection formulas for springs given in MACHINERY'S HANDBOOK, to obtain the actual tension of the spring at full extension L and at its initial length l. If the spring is not sufficiently stiff, either D or L, and in some cases l, must be increased in order to permit the use of larger stock or wire.

The number of active coils N will be given by the formula

$$N = \frac{Edl}{\pi SD^2 + d^2E}$$

and the free length of the active part of the spring or $N \times d$ will be found by the formula

$$\frac{3lL}{5L - 2l}$$

The formula thus obtained for the free length of the spring contains no terms but the lengths of the spring. This formula, therefore, gives that relation between the free length and the working range of a spring that enables the strongest possible tension to be obtained at the initial point.

For example, let a toggle mechanism such as shown in Fig. 3 be considered. In this example a certain space is allowed for length L and for the initial length l, at which point it is desired to have the strongest tension that can be obtained with an extension spring which will operate satisfactorily in the available space. It is therefore necessary to find what free length K will give the desired results.

If length K is made too short, the total deflection $L - K$ will be so great as to require a thin and weak spring in order to obtain the necessary flexibility. If, on the other hand, K is made too long, it will be found that while thicker wire can be used and the total strength at point L will be thus increased, the length l, being relatively nearer to K than to L, will cause the spring to reach its initial length l before its strength has increased an appreciable amount from zero. From this consideration the advantage gained by the use of a formula for obtaining K will be readily appreciated.

Tension springs are sometimes required to come to or assume a definite free length, while the initial and final lengths are also fixed. For instance, springs used in certain types of speed-governing devices must return to a certain length at zero tension. To obtain the strongest possible spring under such conditions, the diameter of the wire d is found by the formula

$$d = D\sqrt{\frac{K\pi S}{E(L-K)}}$$

in which K is the free length of the active part of the spring, and L the active part fully extended so that $L - K$ is the total deflection of the spring. For this spring, the number of coils is determined by the formula

$$N = \frac{K}{d}$$

The foregoing formulas for d and N give the strongest obtainable springs for a given total deflection, that is, if a spring is required for a certain total deflection from the free position, these formulas give the dimensions of the strongest spring that will take that deflection without setting, or in other words exceeding the elastic limit.

Designing Compression Springs

In calculating the dimensions of a compression spring which is to give the maximum pressure at the initial point

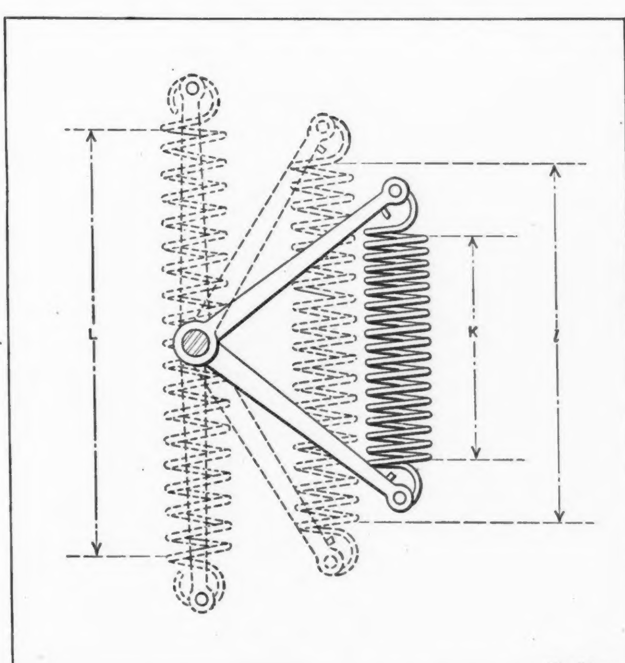


Fig. 3. Toggle Mechanism involving Problem in Spring Design

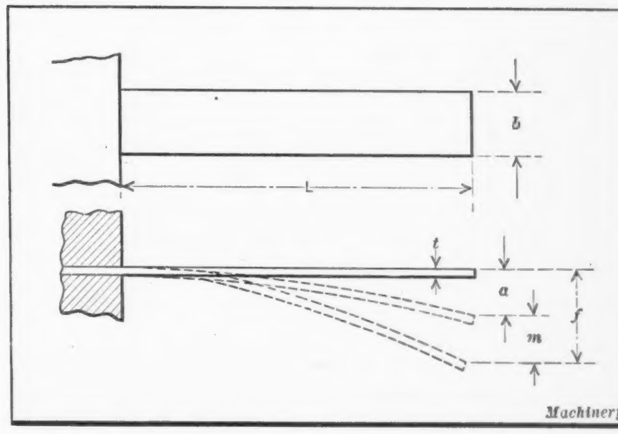


Fig. 4. Diagram illustrating Use of Formulas for Flat Spring Design

and to be subjected to a further deflection without acquiring a set, the closed coils or other end connections that are inflexible are, of course, disregarded. A compression spring can be strengthened by using larger wire, but when this is done there will not be room for so many turns, and beyond a certain thickness or diameter of wire, the number of coils which it is possible to use will not give a spring of the required flexibility.

To find the size of wire that will give the greatest strength with sufficient flexibility, let l, Fig. 2, represent the length of the actual working part of the spring when compressed to its final or minimum working length. The dimension L is the length of the working part of the spring in its initial position or at the beginning of its stroke and is the spring space allowed in the mechanism less the space occupied by the closed coils. The working range m of the spring, therefore, equals $L - l$. The dimensions D and d, and the values S and E, have the same application as in the case of the extension spring. In the case of the compression spring shown in Fig. 2, the maximum pressure it is possible to have at length l will be obtained when

$$d = D\sqrt{\frac{3l\pi S}{5Em}}$$

The number of active coils N comprising the working part of the spring is found by the formula

$$N = \frac{l}{d}$$

and the free length of the active part of the spring is found by the formula

$$\frac{N\pi SD^2}{Ed} + l = \frac{5l}{3} - \frac{2l}{3}$$

In designing a compression spring, it occasionally happens that the free length K, as indicated in Fig. 2, as well as the initially compressed and final lengths, are fixed by the proportions of the mechanism in which it is to be used. Under these conditions, the strongest spring that can be designed is usually required. Examples that illustrate this are governor springs, detent plunger springs, and electric contact brush springs, which must hold their plungers at a certain definite free height so that they can be assembled in the machines in which they are used without pushing the plungers out of their sockets. As an example, let K, Fig. 2, be the free length of the working part of the spring, and l the length when fully compressed. The strongest spring will be obtained when the wire diameter d is determined by the formula

$$d = D\sqrt{\frac{\pi Sl}{E(K-l)}}$$

in which $K - l$ is the total deflection. The number of active coils N in the spring is found in this case by dividing l by d.

Designing Flat Springs

The proportions of flat metal springs can be readily calculated so that with a given length the greatest pressure will be realized at a given point of deflection and with sufficient flexibility to allow a further working deflection. Referring to Fig. 4 the spring is required to work through the distance represented by m. The initial deflection from its free position is indicated by dimension a and the total deflection from its free position by dimension f. Dimension m in an example of this kind is usually fixed by the requirements of the mechanism in which the spring is to be used, while dimension a can usually be varied by changing the form of the spring. The effective length of the spring from the point of support is designated by dimension L, the thickness by t, and the breadth by b. The working bending stress is represented by S and the modulus of elasticity in bending by E. Therefore, under the given limitation of length, the thickness of spring that will give the greatest possible pressure at a deflection a and still retain sufficient flexibility for a further deflection m is as follows:

$$t = \frac{4SL^2}{9mE}$$

The initial deflection a of the spring is:

$$a = \frac{2SL^2}{3Et} - m = \frac{m}{2}$$

This shows that the thickest and strongest spring of given length and width, and for a given working deflection m, can be obtained when the initial deflection a is made one-half the working deflection. After the thickness and initial deflection have been ascertained, the regular formulas for strength and deflection can be used if it is desired to know the actual pressure exerted by the spring at any point. With a flat spring, it is an easy matter to obtain more strength by making the spring wider, but if there is no room for this, more leaves can be added.

When a flat spring is required to come to rest in a certain free position, and to take a certain total deflection giving a maximum pressure in its fully deflected position or at any intermediate position, the formula for the thickness is:

$$t = \frac{2SL^2}{3Ef}$$

in which f is the total deflection. This is like the formula for the thickest spring that will stand a certain deflection.

To Determine when Springs are Overloaded

From the foregoing formula, a useful formula can be derived for determining whether or not a flat spring is overloaded without knowing the actual load upon it, by observing its deflection. The total deflection f should not exceed

$$\frac{2SL^2}{3Et}$$

If the deflection exceeds this amount, it shows that the spring is overloaded. This formula is similar to a more common one which is used to determine whether or not coil springs are overloaded by noting their deflection. The formula referred to in this case is

$$\frac{\pi SD^2}{Ed} \times N$$

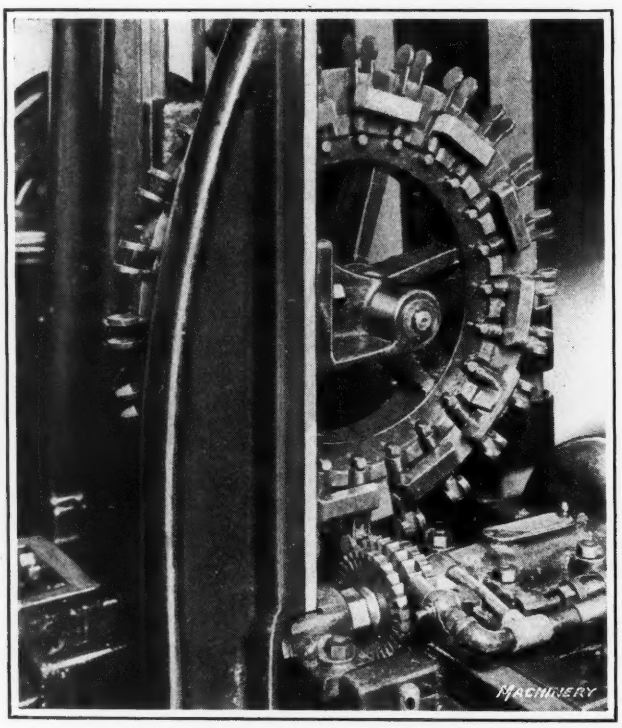
in which N is the number of active coils.

In conclusion it may be mentioned that the formulas given in this article were placed at the disposal of the draftsmen and designers of the Briggs & Stratton Co., Milwaukee, Wis., more than a year ago, and they have proved so useful that they are now employed in proportioning practically all springs used by this company, including delicate flat springs used in electrical instruments and heavy stripper springs used on large drawing dies.

GEAR-CUTTING MACHINE ADAPTED TO STATION MILLING

An unusual adaptation of a Gould & Eberhardt automatic gear-cutting machine in the plant of the Velie Motors Corporation, Moline, Ill., makes possible the milling of drop-forged brake pull-rod yokes on the station milling principle. These forgings are approximately 3½ inches long over all, and the operation consists of milling the two outside and two inside faces of the jaw ends. The accompanying illustration shows the special set-up required for the operation, a large work-holding fixture being mounted on the work-arbor of the machine, and three side milling cutters on the cutter-spindle.

The work-holding fixture provides for holding twenty-four forgings at one time; therefore, the indexing mechanism of the machine is arranged in the same manner as when a spur gear of twenty-four teeth is being produced, the fixture being so secured on the arbor that at the end of each indexing movement, a forging will be in the correct position before the milling cutters. Upon the completion of an indexing movement of the fixture, the cutter-slide advances until the cutters have milled the jaw faces, after which the slide is returned to its original position, the work-holding fixture again indexed, and the previous cycle continued.



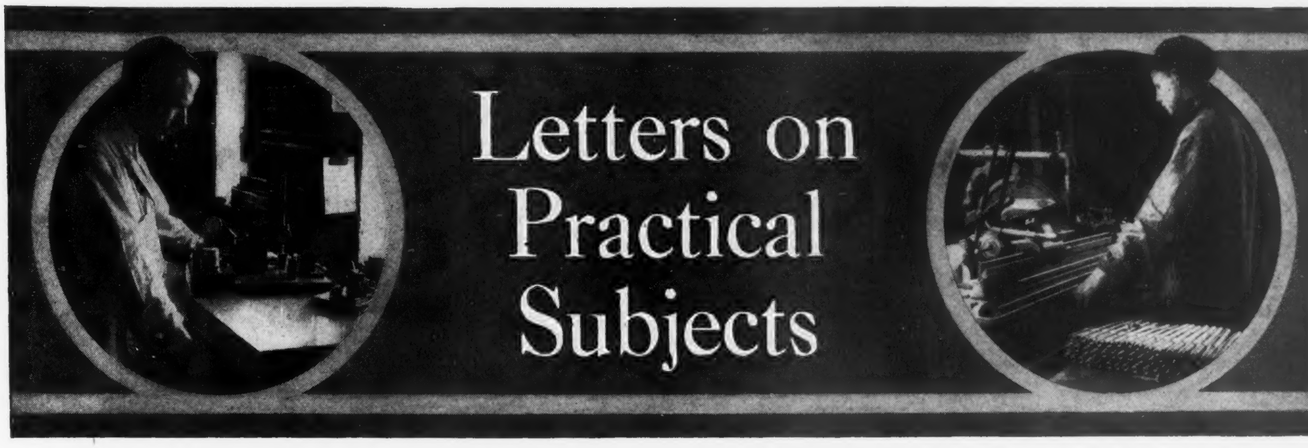
Milling Brake Pull-rod Yokes on Gear-cutting Machine

The operation of the machine is automatic, and the work of the attendant consists only of replacing the finished forgings with unfinished ones as the fixture rotates. The face of the fixture is hollowed out at each station to accommodate the work, and the forgings are located lengthwise by having the shank ends come in contact with projecting pins on the fixture. The clamping members can be swiveled to facilitate unloading and loading the work.

* * *

TAXES ON BELGIAN PATENTS

Belgian patents are now taxed 10 francs during their first year in effect, 25 francs during the second year, 40 francs during the third, 75 francs during the fourth, 100 francs during the fifth, and so on, by increases of 20 francs per year until the maximum of 400 francs is reached. Supplementary patents for the perfection of the original are assessed only once at a fixed amount of 50 francs.



CUTTING CRESCENT-SHAPED GROOVES IN A LARGE ROLL

This description concerns the machining of the driving end of a ten-ton sheet-mill roll. The end of the roll contains four crescent-shaped grooves as shown by the enlarged sectional view in the illustration. It is not usually required to machine these grooves, since the accuracy of the roll does not require such a procedure, but in this particular case it was necessary in order that the roll might be made suitable for a small sheet rolling job. The roll was first turned down on its main and neck diameters in an ordinary roll-turning lathe, after which the equipment illustrated was arranged for cutting the four grooves to form the driving dogs. These grooves are 28 inches long and have a radius of 5½ inches. On account of the size of the work, it was impossible to handle it on any of the regular equipment in the shop. The job was finally performed with the roll mounted in its operative position on the roll-turning table.

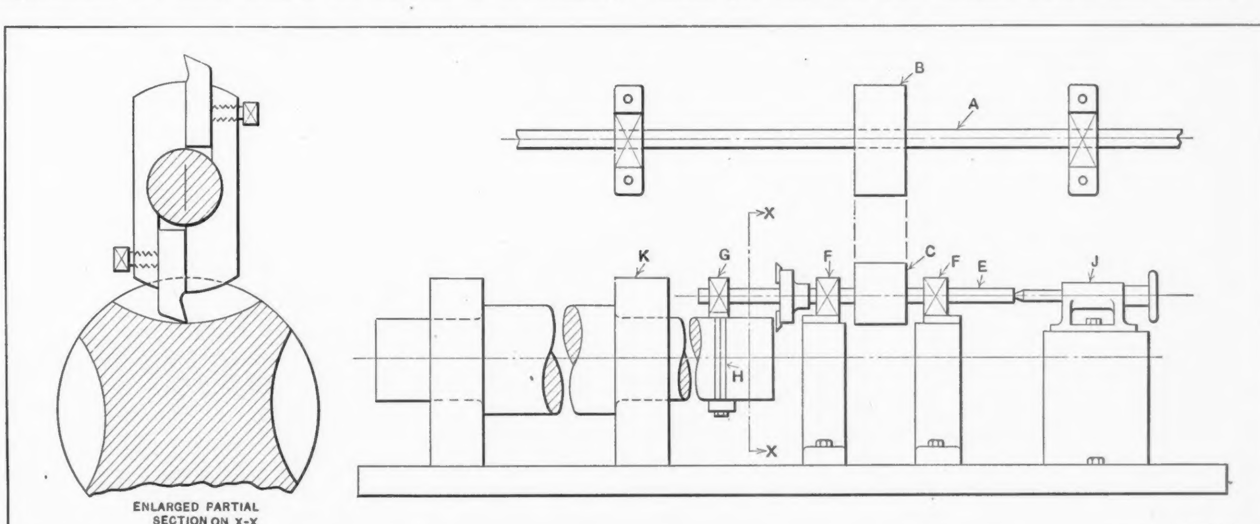
A driving shaft *A*, which was formerly used to drive several machines, was attached to the wall over the roll-turning table in about the position indicated in the illustration. Pulley *B* was fixed to this shaft for driving the boring-bar *E* through another pulley *C* and a 6-inch belt. Pulley *C* was provided with a fixed key so that the boring-bar, which had a corresponding keyway, might slide in it. This bar was supported by bearings *F* on each side of the driving pulley and by the adjustable bearing *G* at the end of the bar. This end bearing was secured to the neck of the roll by long tie-bolts *H*. The relative position of the tools carried in the boring-bar is shown in the enlarged sectional view, which also shows the position of one tool at the bottom of a cut. It will be evident from the illustration that the bar is fed longitudinally by hand through the medium of an ordinary lathe tailstock *J*, the bar sliding through the bearings and pulley *C*.

On account of the length of the grooves and the depth of cut necessary, it was impossible to perform the operation at one setting. After the boring-bar had been advanced sufficiently to bring the tools close to bearing *G*, it was necessary to shift the position of the bearing and of the tool-holder so that the tools could work right up to housing *K*. A considerable amount of overhang was thus caused, but by taking the cuts carefully the job was quite satisfactorily finished. In the completion of the operation, three cuts were taken, the first being ¾ inch deep, the second ½ inch deep, and the finishing cut ¼ inch deep. The boring-bar was driven at a speed of five revolutions per minute, and the total time required to finish the job, including the grinding of the tools, resetting, etc., was four eight-hour days. The accuracy with which the job was accomplished will be appreciated when it is stated that there was only a radial error of 1/64 inch in 28 inches of length.

Cleveland, Ohio C. F. GEORGE

AN ECONOMICAL TOOL-CRIB ARRANGEMENT

A line of highly paid machinists stood waiting before the little window of the tool-crib in a large manufacturing plant. The boy inside was endeavoring to supply each man with the tools required, and although he understood his work, the line of men shortened but slowly. The foreman appeared irritated, and a little thought will show that he had a good reason for showing concern. Multiply the number of men who were waiting by the average time each stood in line, and then multiply by the average number of times per day the line formed before the window and



Set-up of Drive for Boring Tool used in machining Crescent-shaped Grooves in Large Roll

the final result will show a considerable amount of time which the foreman saw slipping away as lost or non-productive time.

The method described in the following offers a means of saving some of this lost time. Probably no one operation takes up so much of the tool-crib man's time as receiving, measuring, and sorting returned drills or reamers, and finding, measuring, and giving out drills or reamers. Sizes stamped upon drills soon become illegible, and regular sized drills, numbered drills, and lettered drills require different gage plates. To avoid mistakes, all drills and reamers should be calipered when checked out and also when returned to the shelves. The provision of a means for facilitating this work, such as that to be described, is therefore the logical method of saving time.

The various drills or reamers are placed on shelves, which are grooved or cleated to separate them, each in the order of its size. Along the front edge of the shelf is fastened, by screws, a strip of iron or steel about 1/8 inch thick and 3/4 inch wide or wider. A hole the exact size of each drill on the shelf is drilled through the plate. The holes are so placed and the grooves of the shelf are so arranged that a drill lies directly behind a hole in the plate which is the exact size of the drill.

The size of the drilled hole is also stamped on the plate. This arrangement provides a drill gage upon the edge of the shelf. The drills lie in the order of their size upon the shelves and the classification—number, letter, regular, or special, as the case may be—is indicated by different colors painted on the plate. If desired, the shelves may also be painted different colors, as, for instance, black for regular size drills, white for special drills, and so on. When given out on check, the drill is calipered in the plate. When returned, very little effort is required to find immediately its size and proper place. F. E. C.

GRADUATING A MICROMETER TO TENTHS OF A THOUSANDTH

During the war, when it was difficult to obtain machinists' tools, even at high prices, the writer had the misfortune to have his best micrometer disappear. This micrometer was graduated to tenths of a thousandth and was the only one the writer possessed with this feature. After an effort to replace the tool had resulted in failure, an older type micrometer was graduated to tenths of a thousandth to take the place of the one that had disappeared. This micrometer was found to give as accurate

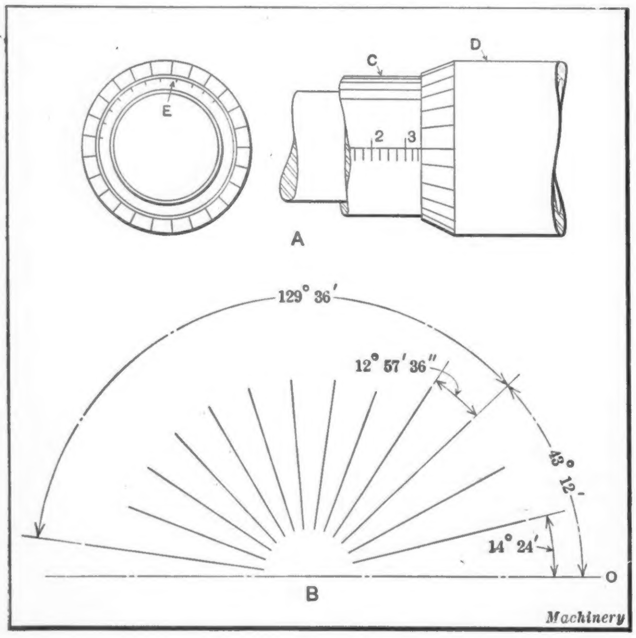


Fig. 1. Diagram showing Angular Spacing of Micrometer Graduations

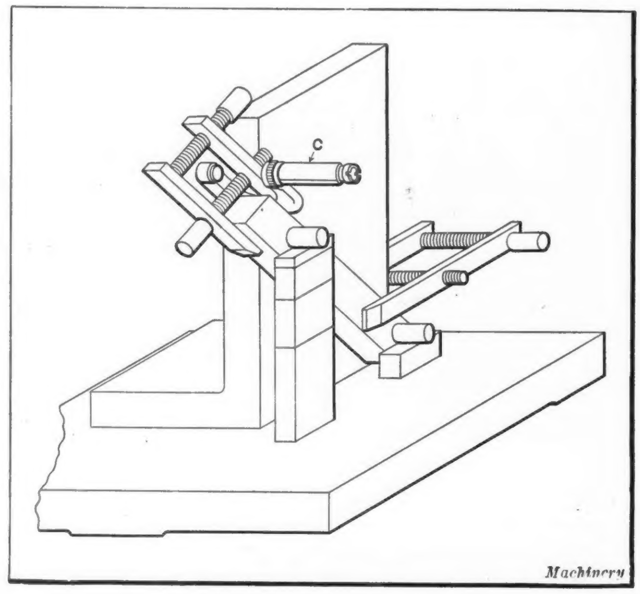


Fig. 2. Method of using Sine Bar to graduate Micrometer Cylinder

results as a standard tool when checked up by the use of size blocks. The accompanying illustrations, Figs. 1 and 2, show how the work of graduating the micrometer was accomplished. In the upper view at *A*, Fig. 1, is shown a section of the cylinder *C* and barrel *D* of the micrometer. At *E* is indicated the relative positions of the graduation lines that were made on the cylinder.

The diagram at *B* shows the angles which it was necessary to take into consideration in graduating the cylinder. As barrel *D* was divided into twenty-five equal parts by the regular graduation lines on its circumference, it is evident that each part or space represented an angle of 360 ÷ 25 or 14 degrees 24 minutes. Nine of these parts, therefore, equalled the ten parts which were to be scribed on cylinder *C* or 9 × 14 degrees 24 minutes. Dividing this result, or 129 degrees 36 minutes, by 10 gives an angle of 12 degrees 57 minutes 36 seconds, which was the angle corresponding to each space between the graduation lines that were to be scribed on cylinder *C*.

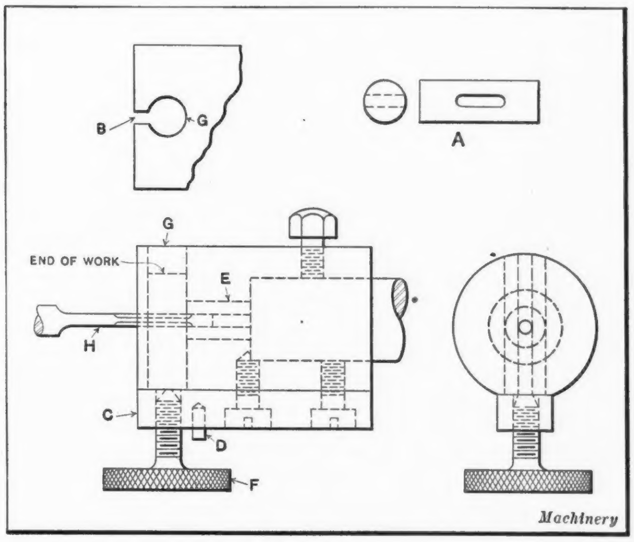
The first line to be scribed was located three spaces above the zero line, or at an angle of 43 degrees 12 minutes with the zero line, this angle being determined by multiplying 14 degrees 24 minutes by 3. The next graduation line was scribed at an angle of 12 degrees 57 minutes 36 seconds to the left of the first line, and the angle of each succeeding graduation was increased by this amount so that the ten divisions represented an angle of 129 degrees 36 minutes or the equivalent of the angle represented by nine divisions of the barrel.

Fig. 2 shows how the micrometer was clamped to a sine bar so that it could be set at the required angles for scribing by the use of standard size blocks. Before scribing the lines, cylinder *C* was given a thin coating of beeswax so that the lines could be etched by the usual method.

New York City G. YOUNGQUIST

LATHE FIXTURE FOR MILLING AN ELONGATED HOLE

The lathe fixture shown in the accompanying illustration was made for use in milling an elongated hole in parts like the one shown at *A*. The body of the fixture is made from a piece of machine steel, bored out at one end to fit the spindle of the lathe tailstock. At the other end, a hole *G* is drilled and reamed through the body and at right angles with the spindle hole, to receive the work. A bushing *E* serves as a support for cutter *H*. A slot *B* is milled across the face of the fixture in line with the hole in which the work is placed, in order to enable the operator to see if the



Lathe Fixture designed for milling Elongated Hole

work is properly located. This slot also facilitates the removal of the work and provides a means of cleaning out the chips.

The piece *C* is held to a slabbed flat on the body of the fixture by two screws, and is tapped to receive the knurled screw *F*. The whole fixture is clamped to the tailstock spindle by a cap-screw as shown. Before placing the work in hole *G* of the fixture, it must, of course, be drilled, so that milling cutter *H* can be passed through it by advancing the tailstock. The hole through the work must be drilled to line up with bushing *E* when the work is pushed up against piece *C*. It will be noted that the cutter is made with a plain end, thus giving a good bearing in the bushing. After locating the work in the fixture, the tailstock spindle is advanced until the plain end of cutter *H* has entered bushing *E* for the purpose of preventing the long slender cutter from springing or breaking under the cut. The work is then fed forward by means of the knurled screw *F*, the head of which comes in contact with stop-pin *D* when the proper length of slot has been machined.

Rosemount, Montreal, Canada HARRY MOORE

A SYSTEM OF FIT ALLOWANCES

The article "A System of Fit Allowances" on page 452 of the January number of MACHINERY was of considerable interest. It has been the writer's experience that the allowances given in tables and charts cannot be relied upon to give satisfactory results unless the length of the hole in the work is taken into consideration. Take, for example, an electric car wheel having a bore diameter of 4 inches and a hub 4 inches long. An allowance of 0.015 inch gives a pressure of about 35 tons, which is the pressure recommended by the car wheel foundry. Nevertheless this allowance is greater than that shown on the chart. In the case of a different type of wheel having a hub 15 inches long and a bore 5 1/8 inches in diameter, an allowance of 0.002 inch gives a pressure of fifty tons which is excessive, and this necessitated cutting a recess at the center of the hub so that it would have a bearing only at the ends. In this case the allowance of 0.002 inch is much less than that given in the chart for a 5-inch hole. It is always preferable to taper slightly the parts that are to be a press fit, as otherwise the wear resulting from pressing the parts together will affect the tightness of the fit.

As an experiment a 1 1/8-inch hole was drilled and reamed in the center of an iron block 3 by 4 by 3 inches. A pin 0.004 inch larger than the hole for about 3 inches of its length and 0.010 inch larger for the remaining 3 inches of its length was turned up and pressed into the hole in the block. It required a pressure of 3 tons to force the small end of the pin into the hole and a pressure of 6 tons for the larger end of the pin. It is probable that if the casting had been much lighter it would have been cracked or fractured by this pressure. In pressing pins into holes in steel hubs, the pressure is generally higher for the same allowance than it is for cast iron. However, a tighter fit is required in steel than in cast iron.

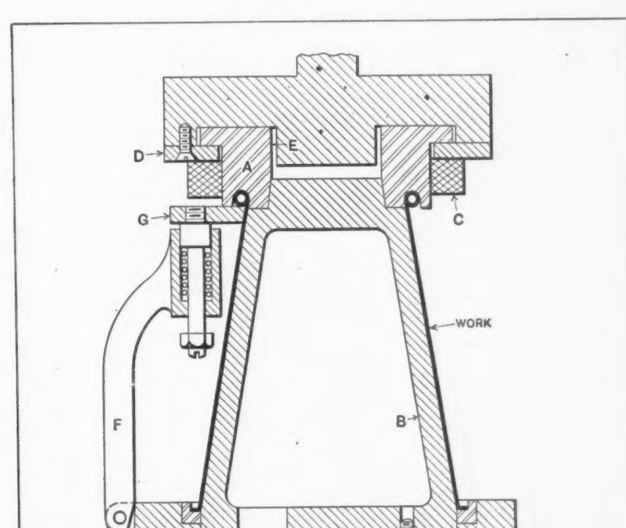
A pressure of 60 tons was required to press a shaft having an allowance of 0.004 inch into the hub of a cast-steel pinion having a 6-inch bore and a hub length of 12 inches. As this pressure was excessive, a recess was bored in the center of the hub leaving a bearing of 2 inches at each end. In this way the pressure required to assemble the parts was reduced to 25 tons. The charts in the article in the January number of MACHINERY previously referred to give approximately the correct fit allowance when the length of the hub is about the same as the diameter of the bore. Therefore, when using these charts this should be borne in mind, and in case the length of the hub exceeds the diameter of the bore, a recess should be bored in the hub if possible, leaving bearing surfaces at the ends of the hub, the combined lengths of which are approximately equal to the diameter of the bore.

Portland, Me. H. K. GRIGGS

[The pressure required for assembling cylindrical parts depends not only upon the allowance for the fit, but also upon the area of the fitted surfaces, the pressure increasing in proportion to the distance that the inner member is forced in. The physical properties of the material from which the parts are made, as well as the outside diameter of the outer member, must also be taken into consideration in calculating the pressure required to force the parts together. On page 885 of MACHINERY'S HANDBOOK is given a formula which, when used with the table of constants accompanying it, will give the approximate pressure required to force a machine-steel shaft into a cast-iron hub when the fit allowance, diameter of the hole, and length of the hub are known.—EDITOR]

WIRING AND FLANGING DIE WITH EXPANDING PUNCH

In the manufacture of coffee pots of the seamed type, the die shown in the accompanying illustration is employed to flange the bottom end and to wire the top. An unusual feature of this die is that punch *A* is composed of five sections which are moved radially from the center of the punch-



Punch and Die for wiring and flanging Coffee Pots

holder as they are forced over the tapered surface of the work-holder *B* on the downward stroke of the ram. By this arrangement the wiring edge of the punch is expanded to correspond with the increased diameter of the shell. The punch sections are again forced together on the return stroke of the press, by means of the heavy rubber ring *C*.

The sections of punch *A* are attached to the punch-holder by means of ring *D*, there being a sliding fit between the punch sections and the surfaces of the parts with which they come in contact, so as to permit easy movements. In making the punch sections, they are first turned to the proper outside diameter, bored to the smaller inside diameter, and machined on the sides which make contact with the adjacent sections, so that they will fit well when assembled on the punch-holder. After being mounted on the latter, the lower end of the opening of the sections is turned to the largest diameter to which the sections must expand, and then the opening is tapered to coincide with the tapered surface on work-holder *B* with which the sections engage. Next the sections are again machined on their adjacent faces to permit the inside faces *E* to be drawn in contact with the projecting cylindrical surface at the center of the punch-holder.

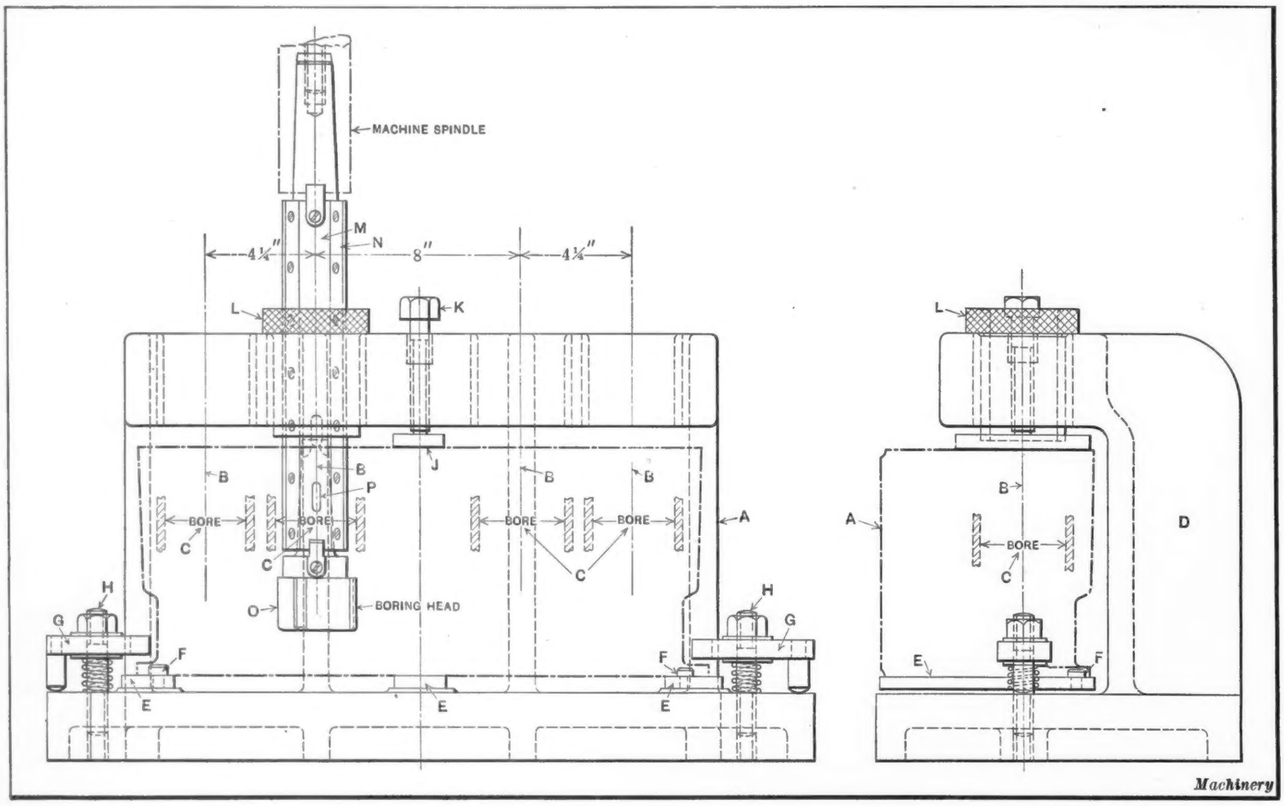
The illustration shows the various parts in the positions occupied at the completion of the downward stroke of the press. Prior to an operation, work-holder *B* is raised by pins bearing against its base, which are actuated by a rubber buffer beneath the die. The movement of the work-holder is regulated by the heads of screws attached to the base which operate in counterbored holes in the die-block. In order to slip work over the holder, it is necessary to swing three arms *F* away from the die. After the work has been located, these arms are returned to the position shown, and a ring of wire formed in a preceding operation is laid on the upper surface of three supports *G* and around the end of the tapered shell.

Supports *G* are spring-actuated, being raised an amount dependent upon the position of the adjustable nut on the rod, by means of which each support is held to its respective swinging arm. Upon the downward stroke of the press ram, the upper end of the shell is forced around the wire on supports *G* as the expanding punch comes in contact with the work, and the flange at the bottom of the shell is formed by forcing the shell on a hardened ring in the die-block as the work-holder is pushed down. In similar operations where the small end of the work is not wired but simply curled or beaded, the construction of the punch and die may be identical with those described except that arms *F* and their attached parts are unnecessary.

Toledo, Ohio J. Bingham

CYLINDER BORING FIXTURE

The fixture shown in the accompanying illustration was designed for use on a heavy-duty Moline "Hole Hog" for finish-boring a four-cylinder automobile engine cylinder block *A* represented by the heavy dot-and-dash lines. The position of the four cylinder bores is indicated by the partial sections *C*. In the illustration only one boring-bar is shown, the other three being omitted as they are of the same construction. The four boring-bars are located in line at intervals indicated by the dimensions between the vertical center lines *B* of the cylinder bores.



Fixture used in boring Cylinder Block for Four-cylinder Engine

The body of the fixture *D* is of the heavy U-type design, which enables the work to be slid into the fixture from the front of the machine, the three hardened guide strips *E* serving as supports for the work while it is being slid into place. Pins *F*, which fit into the end strips *E*, locate the work in position for performing the finish-boring operation. The work is clamped in the fixture by means of two end clamps *G* actuated by screws *H*, and by clamp *J* actuated by screw *K*. The pressure exerted on the work by these clamps is directed against the hardened guide strips. This method of clamping prevents distortion of the casting and insures bores that will be square with the base of the cylinder block.

Guide bushings *L* are provided for each of the boring-bars *M*. These bushings are of the slip type, and are made 5 inches long in order to insure a rigid guide for the bars. Bar *M* is of the built-up type having four hardened strips *N* attached to the body by machine screws. These strips serve as bearing surfaces in slip bushing *L*. The boring-head *O* is separate from the bar and is of the inserted-blade type

having three blades. This head is held in the bar by means of a Morse taper shank and a wedge *P*.

The design of this bar permits the boring head to be removed for grinding the cutters, without taking the whole bar from the fixture and machine spindle. This fixture enables cylinder bores 9 inches long to be bored accurately so that there will be practically no error as to straightness and squareness with the base.

Pittsburg, Pa. WILLIAM OWEN

CUTTING GEARS HAVING A PRIME NUMBER OF TEETH

In the following, is described a method of cutting a gear having a prime number of teeth, by the use of an ordinary indexing head equipped with a standard index-plate. Fig. 1 shows a gear with 179 teeth being cut by the method described. The first step in setting up the machine was to find an indexing circle that would give as nearly 179 divisions as possible, or in this instance 180 divisions or spaces. The number of holes in this circle (54) was multiplied by 40, which is the number of turns of the indexing head worm required for one complete revolution of the work.

Thus 54 times 40 equals 2160, and this number divided by 179 or the number of teeth desired gives 12 12/179, which is approximately 12 1/15. The error occurring in these fractions is so slight that it need not be considered. Therefore, to cut 179 teeth it is evident that the indexing pin should be moved 12 1/15 spaces on the 54-space circle for each tooth, but in order to solve the problem of indexing a fraction of a space, a chart as outlined in Fig. 2 was designed and mounted on the index-head. By the use of this chart, the pin could be indexed exactly 12 holes and the fractional part of a division obtained by an additional movement of the index-plate.

The chart was laid out as follows: A circle of about 15 inches in diameter was drawn on manila paper. One-half of this circle, or 180 degrees, was then divided into 27 spaces to represent those on the index-plate. Commencing at the sixth line, each of the following 12 spaces was subdivided into 15 sections, making a total of 180 divisions. The chart was then given a thin coat of shellac, after which it was tacked on a board and mounted firmly on the dividing head, care being taken to have the chart concentric with the index-plate. This was easily accomplished by drawing a circle *A* on the chart having a diameter equal to that of the index-plate.

In connection with this chart, it was necessary to provide a hand *B*, Fig. 1, which was made of an old saw blade and riveted to a piece of square cold-rolled steel *C*, which was, in turn, soldered to the outside edge of the index-plate. The stop which holds the index-plate in position was released, so as to allow the latter to turn. In setting the ar-

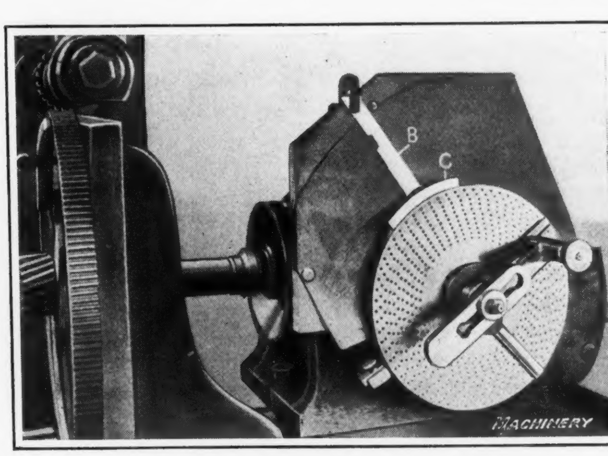


Fig. 1. Index-head equipped for cutting Gears having a Prime Number of Teeth

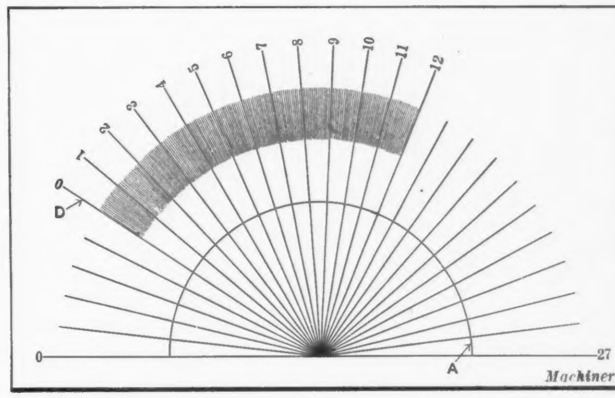


Fig. 2. Diagram showing Lay-out of Chart employed in Connection with Index-head

rangement in position, the indexing pin was placed in the zero hole of the 54-hole circle, and hand *B* on the first line *D*, Fig. 2, of the lay-out, where it was secured in position by means of a small clamp.

For each tooth cut, the index-pin was advanced 12 holes in a clockwise direction, the clamp on hand *B* loosened, and the bar moved ahead one division. The result showed, at the 179th cut that by advancing the hand on the chart one line per cut, the 180th tooth had been eliminated, or in other words, 179 teeth had been cut. In checking the gear for accuracy, it was found that at no place did it show a discrepancy of more than 0.0015 inch. A gear of 181 teeth could, of course, be cut by using the same chart, if the indexing pin is operated in a clockwise direction, and the hand on the chart in a counter-clockwise direction.

Plainfield, N. J. HENRY DAUT

PULLEY-CROWNING TOOL FOR TURRET LATHE

A device for crowning pulleys, which has been developed for use on a turret lathe and which has proved quite successful, is shown in the accompanying illustration. This tool was designed to be employed in conjunction with other tools mounted on the turret, to provide a means of completing the machining of crowned pulleys such as shown at *P*, at one setting in the chuck of the turret lathe. The operations performed on this pulley prior to crowning, which is the last operation, are as follows: Boring and reaming the hole; facing one end of the hub and back-facing the other end; rough-turning the periphery of the pulley straight, and facing the two edges.

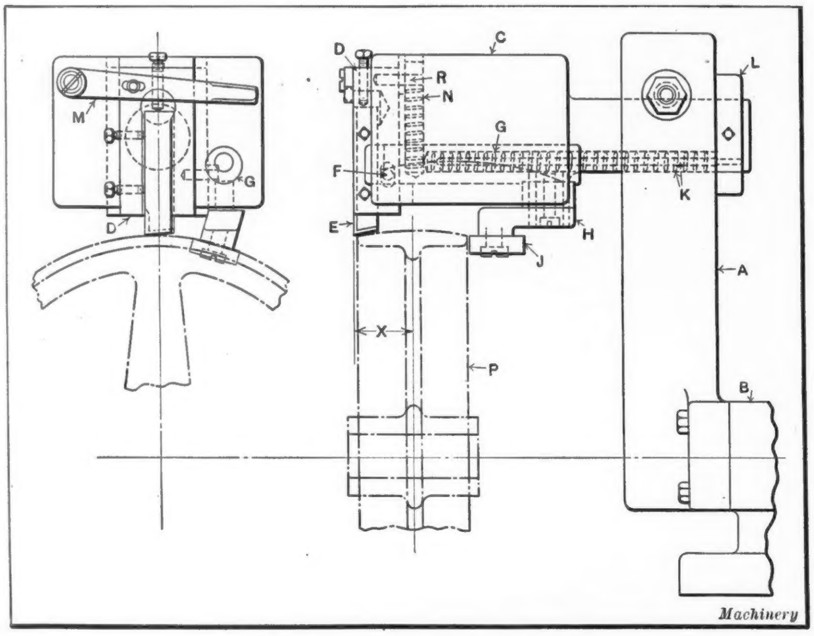
Referring to the illustration, *A* is the tool-holding member which is attached to one face of the turret at *B*. In this holder is mounted the body *C* of the crowning tool, which is clamped in place by screws (not shown). In body *C* is mounted a slide *D* which carries a cutting tool *E* and also a pin *F* projecting into an elongated slot in body *C*, so that it can move up and down with the slide. Another important member of this tool is the forming bar *G*. To this bar is attached, by screws, a block *H* which carries a roller *J*. A spring and stud *K* attached to a collar *L* enter a hole in bar *G*. These parts, with the exception of lever *M*, complete the essentials of the tool, the operation of which is described in the following:

With the pulley finished, except for crowning, the turret-slide is advanced until roller *J* (which is then in its extreme forward position or slightly advanced beyond the cutter) comes against the edge of the pulley rim. As the turret continues to advance, block *H*, being prevented from moving forward, remains stationary and also prevents further forward movement of forming or templet bar *G*. Now as body *C* continues to advance, it slides over bar *G* and when pin *F* comes in contact with the formed guiding surface or templet of bar *G* slide *D* is caused to slide in body

C so that the cutter will turn the crowned surface on the pulley to correspond with the contour of the curved surface of the templet bar *G*.

Pressure is exerted by spring *N* on pin *R*, so that pin *F* in slide *D* is kept in contact with the formed templet surface of bar *G*, except when the slide is advanced by hand by lever *M*, so that the turret can be brought up to a fixed position to facilitate adjusting the cutter in its proper position relative to bar *G*.

In tracing the detail drawing of body *C* and bar *G*, blank circular spaces are left for certain dimensions so that the proper lengths may be filled in on the blueprints when making tools to accommodate pulleys of different size. This tool provides a successful and economical means of performing the class of work described, being an application of a single-point tool for forming operations on a turret lathe. This method is often found preferable to that of employing a broad formed tool for work of this kind. F. H.



Pulley-crowning Tool for Turret Lathe

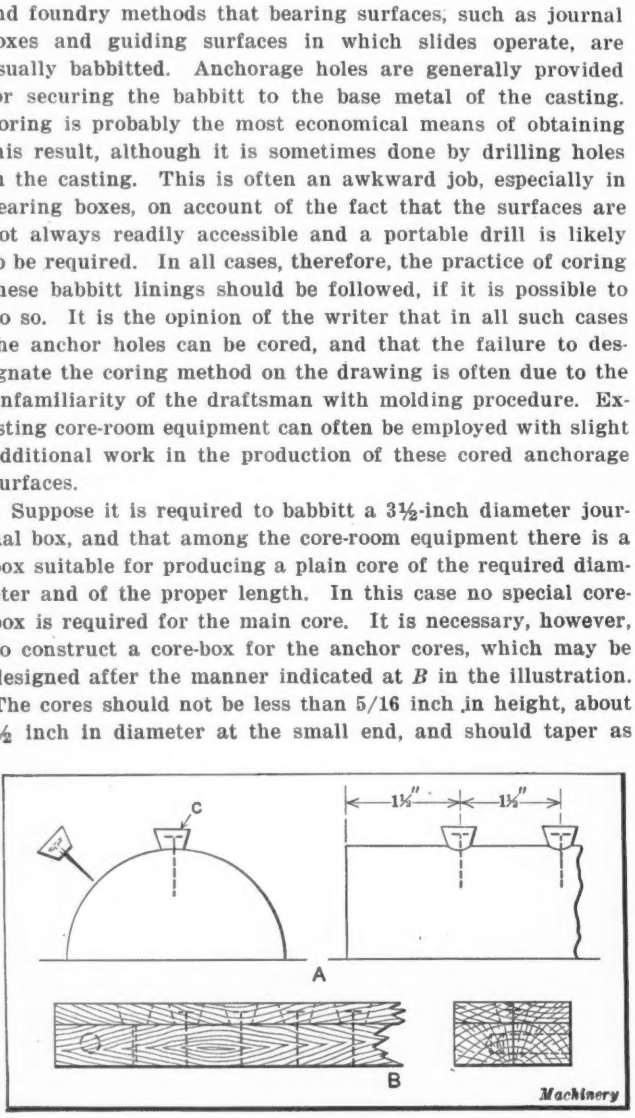
ANCHORING BABBITT LININGS TO CASTINGS

It is commonly known by those familiar with pattern shop and foundry methods that bearing surfaces, such as journal boxes and guiding surfaces in which slides operate, are usually babbitted. Anchorage holes are generally provided for securing the babbitt to the base metal of the casting. Coring is probably the most economical means of obtaining this result, although it is sometimes done by drilling holes in the casting. This is often an awkward job, especially in bearing boxes, on account of the fact that the surfaces are not always readily accessible and a portable drill is likely to be required. In all cases, therefore, the practice of coring these babbitt linings should be followed, if it is possible to do so. It is the opinion of the writer that in all such cases the anchor holes can be cored, and that the failure to designate the coring method on the drawing is often due to the unfamiliarity of the draftsman with molding procedure. Existing core-room equipment can often be employed with slight additional work in the production of these cored anchorage surfaces.

Suppose it is required to babbitt a 3½-inch diameter journal box, and that among the core-room equipment there is a box suitable for producing a plain core of the required diameter and of the proper length. In this case no special core-box is required for the main core. It is necessary, however, to construct a core-box for the anchor cores, which may be designed after the manner indicated at *B* in the illustration. The cores should not be less than 5/16 inch in height, about ½ inch in diameter at the small end, and should taper as shown at *C*. The core-box for these anchor cores should be split longitudinally on the center line, as shown in the end view. The upper part of the core-box is made of two pieces of wood of the same thickness as the depth of the core, and the bottom part should be deep enough so that the nail which is subsequently baked in the core may not protrude beyond the bottom of the box. These two lower halves are doweled together, and small holes are drilled through at the parting to accommodate the nails. The position of these nails is indicated in the illustration. The nails are pressed into the holes so as to bring their heads about in the center of the core pocket.

The upper part of this illustration shows a plain half-core for a bearing, lying on the drying board. The small anchor cores should be made up in quantities and kept in stock so that they may be used when desired, by inserting them into the unbaked cores in the manner indicated in the illustration. These small cores should be arranged in rows, either straight or zigzag, as desired. The green sand half-cores, with the small ones inserted, are then placed in the oven and baked, and the two halves stuck together in the regular way. In the illustration, these cores are shown arranged in straight rows spaced 1½ inches apart, but this merely furnishes an idea of an arrangement that might be followed for a core of this size. The finished core is set in the mold in the regular way.

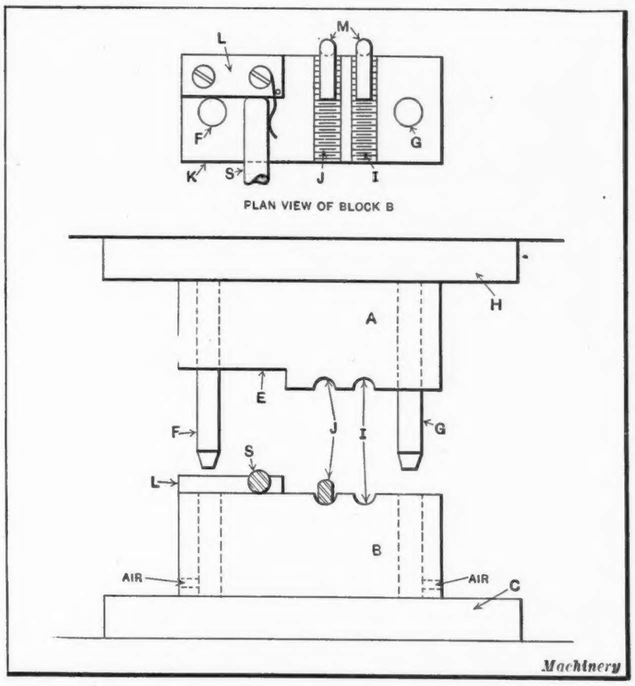
Kenosha, Wis. M. E. Duggan



Core-box for making Anchor Cores, and Method of placing them in Main Bearing Core

DIE FOR FORMING SCREW THREADS ON A POWER PRESS

The accompanying illustration shows a small die used on a Toledo press for forming threads on soft steel wire rods 0.2437 inch in diameter. The specifications for this job called for 1/4–20 threads on which semi-finished hexagon nuts could be screwed. These nuts, after being screwed on the rods, were to be tin-plated, and were not required to be removed. As the work could not be done on any of the thread-cutting machines in the shop without interfering with other work, and as the press room at the time was not overloaded with work, it was decided to use a small Toledo press for the job by equipping it with a suitable die. The die developed for this purpose consisted of two tool-steel blocks *A* and *B* provided with guide pins *F* and *G*. Blocks *A* and *B* are attached to cast-iron shoes *C* and *H* by means of screws. Shoes *C* and *H* are, in turn, fastened to the bolster plate and ram, respectively.



Die used to form Screw Threads on Soft Steel Rod

In making the dies, blocks *A* and *B* were clamped together and drilled and tapped with a 1/4–20 tap at *J* and *I*. After this had been done, the blocks were separated and a step *E* planed on block *A*. When the die is in operation, the stock *S* is placed on face *K* against stop *L* where it is swaged or flattened on the first stroke of the press. On the second stroke the stock is placed in the threaded groove *J* in an edgewise position against stop *M*, so that when the blocks come together the metal is subjected to pressure which causes it to conform with the thread grooves in the die. This forces out the flat sides which were produced by swaging. Threaded groove *I* serves as an extra groove to be used only when the first one becomes excessively worn or chipped. The purpose of swaging is to keep the metal from running or flowing outside of the thread-forming portion of the die and thus forming fins where the two guide blocks come together. A few trials were made to determine the proper depth of step *E* in order to have just enough metal to fill the thread die. The dies were lubricated with a mixture of lead and oil. The threads produced on this die proved to have sufficient accuracy and strength to meet requirements satisfactorily.

West Lafayette, Ind. M. A. BLU

SEMI-AUTOMATIC ADJUSTABLE CENTER-PUNCH

The tool shown in the accompanying illustration was designed by the writer after observing the comparatively crude methods employed in laying out and center-punching copper bars for drilling. It was made primarily to enable the coppersmith to center-punch copper bars more rapidly and with greater accuracy than could be done by the usual method. However, the application of this punch may be extended to include bar stock of any material, if the size comes within its range of adjustment.

The time required for setting up and adjusting the tool to the stock makes it impracticable for use when less then ten or twelve pieces are to be center-punched, but when a larger number of pieces are involved its use results in a distinct saving in time. The original method of laying out and center-punching by hand requires the use of five tools—a try-square, a scale, a scratch-awl, a center-punch and a hammer. When the device shown in the illustration is employed, it requires only the use of a hammer. The following table shows a time study or comparison of the two methods:

Old Method

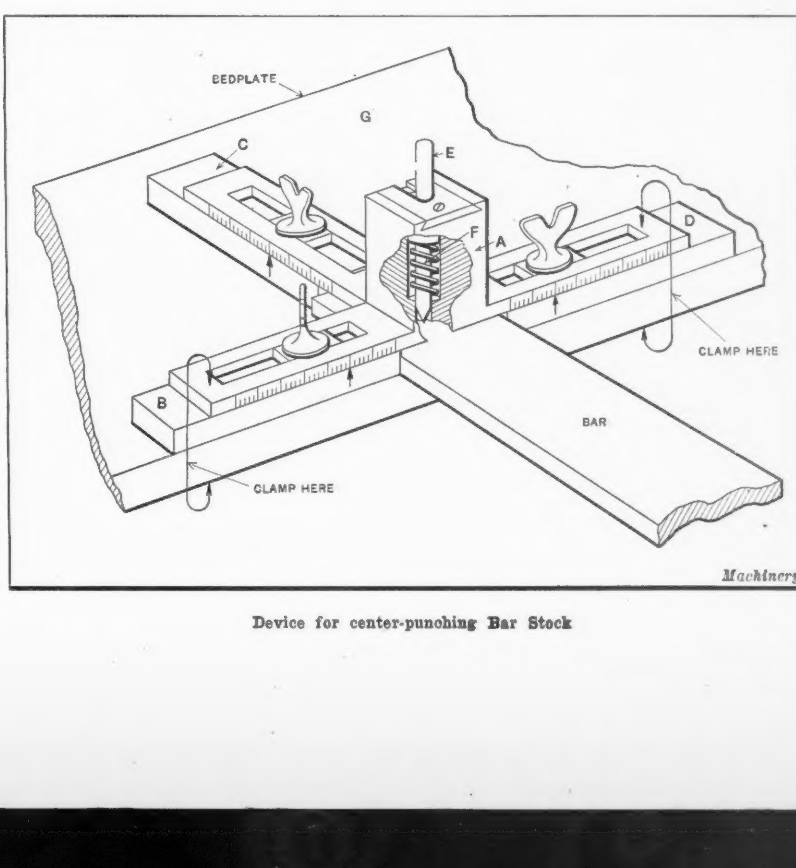
Operation	Time, Hours
Lay bar on table	0.0005
Pick up square and place on bar crosswise	0.0008
Pick up scale and move square to the proper distance from the end of the bar	0.0010
Lay scale aside	0.0003
Pick up scratch-awl and scratch line crosswise	0.0011
Mark bar in two places the proper distance from edge	0.0017
Turn square lengthwise with bar and scratch line through the two points just marked	0.0013
Lay square and awl aside	0.0004
Pick up center-punch and hammer	0.0009
Place point of punch on intersection of two lines and punch	0.0010
Lay punch and hammer aside	0.0004
Lay bar aside	0.0004
Total time per hole	0.0098

New Method

Operation	Time, Hours
Take bar and place end in punching tool	0.0011
Punch	0.0004
Lay bar aside	0.0004
Total time per hole	0.0019
Saving per hole	0.0079
	0.0098

Under the ideal conditions of having sufficient work to keep the tool in use continuously, production would be increased about 400 per cent, and the direct labor cost reduced about 80 per cent. From this table the approximate saving in time with the new tool is readily apparent. The greater accuracy obtained by the use of the adjustable center-punch results in less scrap and a better product. The work is also made easier for the worker as eye-strain resulting from reading scales is eliminated after the tool is once adjusted.

The body *A* is made of forged steel, and is machined accurately to insure close sliding fits for the guide blocks on slides *B*, *C*, and *D*. The center-punch *E* is made of tool steel and is accurately ground. A spiral spring *F* holds the punch up so that it clears the opening in which the bar is located when performing the punching operation. It will be noted that scales or graduation marks are provided on the arms which extend from body *A*. It will also be seen that indicating points are scribed on sliding blocks *B*, *C*,



Device for center-punching Bar Stock

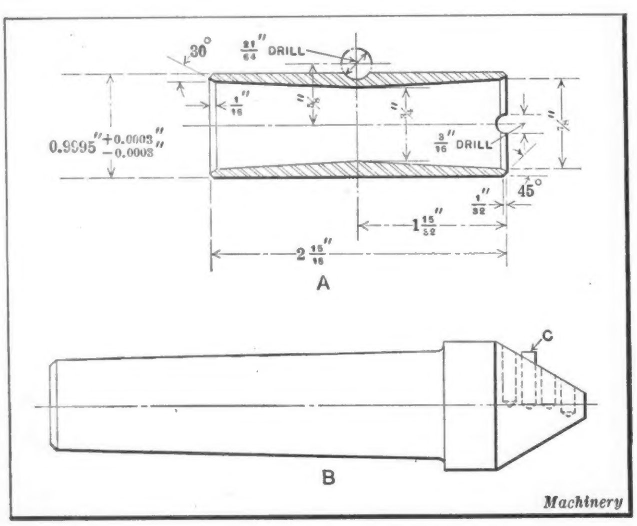
and D. By the use of these scales the sliding blocks can be quickly adjusted for any width of stock and any desired location of the center mark within the capacity of the tool. After the slides have been properly set, the device should be clamped down to an iron or steel bedplate G, as shown, or the top of a bench in order to provide a solid foundation which will insure rigidity. By placing blocks under the sliding members B, C, and D, the tool can be employed for center-punching stock of considerable thickness. With this tool the operator can hold the hammer in one hand and use the other for picking up the bar, inserting it in the fixture, and laying it aside.

Swissvale, Pa. S. M. LOWRY

MAKING PISTON-PINS

The piston-pin shown at A in the accompanying illustration is used in the motor of a high-grade car, the design of which has been carefully worked out with a view to obtaining light weight combined with great strength. In order to accomplish this, each part of the car is carefully proportioned and made of the strongest material available. In the case of the motor piston-pin, the material selected was alloy steel tubing. By using 1-inch tubing, 0.020 inch over size, the only operation required in finishing the outside diameter to size is a finish-grinding operation, which is performed after the pin has been hardened. This method of using over-size tubing proved to work out very well, and not only saves material but considerable work as well. The procedure in machining the pin is easily followed by referring to the accompanying operation sheet, which shows the various operations required and the equipment used.

After cutting off to the length specified in the operation sheet, the pieces are carburized and then finish-bored to size. This removes the carbon from the inside so that later, when



Piston-pin, and Lathe Center used when grinding Outside of Pin

hardening, the inner surface will be left soft, while the outside surface will be hard, thus giving a tough but elastic tubing which will stand up under the pressure exerted by the explosions in the cylinder. By performing the boring operation after the work has been carburized, the usual process of packing the holes in the pins for the hardening operation is eliminated. Operation 6 is quickly performed in a drilling machine. Operation 8 consists of grinding a 30-degree chamfer at each end of the hole in the pin. The surfaces thus ground serve to locate the pin on centers when grinding the outside diameter. In the latter operation, which completes the machining of the pin, a special center shown at B is employed. This center is provided with a pin C which engages the notch produced by the 3/16-inch drill at the end of the piston-pin. It will be noted that

OPERATION SHEET FOR MAKING PISTON-PINS

Oper. No.	Operation	Machine	Tool and Number
1	Anneal tubing	Furnaces	
2	Saw off tubes 3 1/16 inches long	Power saw	
3	Carburize (do not harden here)..	Furnaces	
4	Chuck in soft jaws............	W. & S. screw mach.	
	A. Face end	W. & S. screw mach.	
	B. Drill through 11/16 inch	W. & S. screw mach.	
	C. Bore through 3/4 inch ± 0.003 inch	W. & S. screw mach.	
	D. Ream taper hole in one end	W. & S. screw mach.	Reamer No. 1316-T-2
5	Reverse piece		
	A. Face to length (2 15/16 inches)	W. & S. screw mach.	
	B. Ream other end		Reamer No. 1316-T-2
6	Drill 21/64- and 3/16-inch holes in pin	Drilling machine	Drill jig No. 1316-T-1
7	Harden pins	Furnaces	
8	Grind 30-degree chamfer at both ends	Grinder	Collet No. 1316-T-5
9	Grind outside diameter to size (0.9995 inch ± 0.0003 inch)..	Grinder	Special centers No. 1316-T-3

Machinery

there are four drilled holes in the conical end of this center, which permits pin C to be properly located for piston-pins of different sizes.

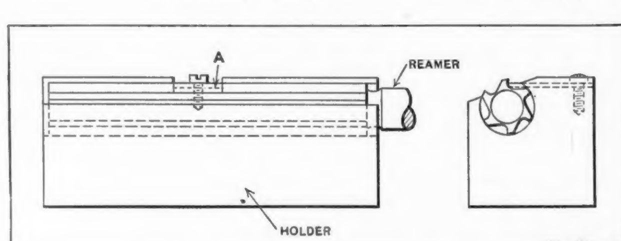
Irvington, N. J. C. H. DENGLER

HOLDER FOR STONING REAMERS

The accompanying illustration shows a simple device made by the writer to facilitate the stoning down of small reamers, a large number of which were required to be reduced about 0.002 inch on their diameters. As the small reamers were awkward to hold in the hand, this holder proved to be a great convenience. Without the holder the stone had a tendency to rock. Moreover, with the position of the teeth constantly changing, it was a difficult matter to determine the proper angle at which to hold the stone in order to give the cutting edges the correct amount of clearance.

One advantage of the holder is that it permits both hands to be used in manipulating the stone. It also locates each cutting edge in the same position for stoning, thus enabling a uniform clearance to be maintained. The holder is made from a piece of square stock drilled for its entire length, as shown, with a drill the size of the reamer. After drilling the hole in which the reamer is to be located, the corner of the block is ground and filed away to expose the reamer blades. A groove cut in the top of the holder is supplied with a piece of saw blade A held in place by a round-head screw. The piece A serves as an index stop, and not only prevents the reamer from turning while it is being stoned, but also locates each succeeding cutting edge in the same position for stoning as it is indexed into place.

Rosemount, Montreal, Canada HARRY MOORE



Reamer-holder used in stoning down Cutting Edges

SHOP AND DRAFTING-ROOM KINKS

SLIDE-RULE KINK

Almost all users of the slide-rule experience more or less difficulty in placing the decimal point in the quotients and products when performing simple arithmetical calculations. The difficulty is due principally to the fact that the rule governing this is not easily memorized. Accordingly, the writer devised the table shown, in which these rules are graphically presented. Its use will greatly aid in slide-rule work, if the table is hung on the wall or some other place where it can be plainly seen. The letters L and R refer to the end of the rule from which the slide projects—that is, left and right. Letters a and b represent the number of digits to the left of the decimal point in the two multiplication factors, or in the dividend and divisor when the arithmetical operation is division. By this handy graphic method, the number of places in the product and quotient may be quickly determined.

TABLE TO AID SLIDE-RULE WORK

L		R	
×	$a + b$	×	$a + b - 1$
÷	$a - b$	÷	$a - b + 1$

Machinery

Baltimore, Md. HENRY R. BOWMAN

FALSE JAWS FOR AIR-HAMMER REPAIR VISE

A little kink which the writer has found useful in repairing air-hammers is to provide a bench vise with false jaws made from leather belting. This enables work to be held in the vise without distorting it or injuring finished surfaces. The false jaws are made in the form of disks and are provided with split pins *D*, as shown at *B*, Fig. 1. Three of these disks are attached to each jaw of the vise by drilling 3/16-inch holes in the jaws, as indicated at *C*, Fig. 2. Of course two disks can be attached to one jaw and only one disk to the opposite jaw if a three-point grip on the work is desired, or the disks can be arranged in any way that will provide the best means for holding the work. The 3/16-inch holes are countersunk to facilitate inserting the pins *D*, Fig. 1, which are driven tightly into the leather disks and remain in them when they are removed from the vise.

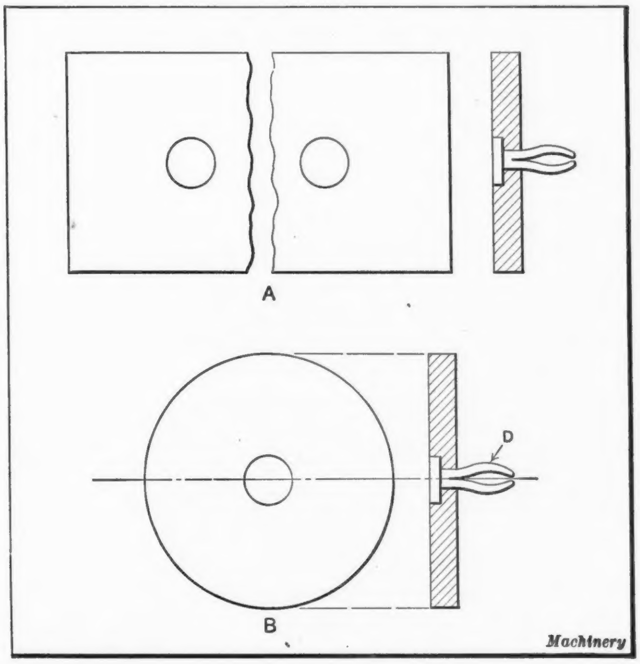


Fig. 1. False Jaws for Bench Vise

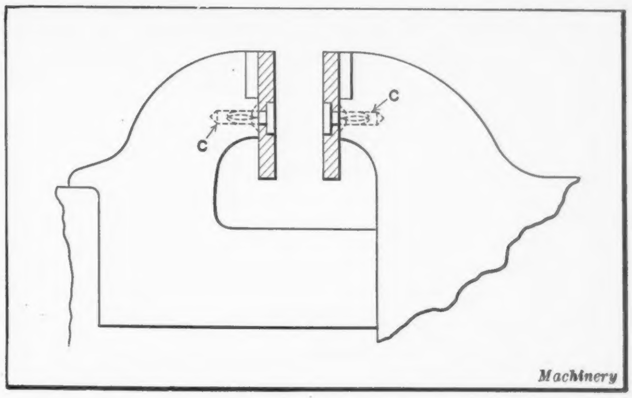


Fig. 2. Diagram showing how False Jaws are attached to Vise

The disks or false jaws can be attached quickly by simply inserting the pins in the 3/16-inch countersunk holes. The reason for using circular disks is that grooves are formed much quicker in straight jaws like the one shown at *A*, which must always be located in the same position, whereas the disks can be turned around so that new surfaces are presented for gripping the work as soon as grooves begin to form in the leather.

The disk jaws do not project over the vise jaws, and the spaces between them can be used for gripping work in the regular way without their removal. For work which requires a soft surface the whole length of the vise jaw, a strip of leather like that shown at *A*, Fig. 1, can be used in place of the disks. It might be mentioned that three shingle nails driven through the leather quite close together may be used in place of the split pins to hold the false jaws in place.

Saint Paul, Minn. ARTHUR MUNCH

ENAMELING COMPOSITION

An enameling composition consisting of 25.55 per cent sand, 22.33 per cent feldspar, 32.98 per cent borax, 9.58 per cent soda, 3.20 per cent fluor-spar, 3.20 per cent saltpeter, 2.12 per cent black oxide of manganese, 0.80 per cent cobalt, and 0.21 per cent oxide of copper may be used as a slush coat for enameling sheet-metal articles. The application of enamel by slushing consists of pouring the enamel over the surface to be coated and allowing it to drain off and dry. The ingredients should be melted together, after which 10 per cent of clay should be added to the melt. The mixture should be burned not less than four hours in the muffler. The ingredients listed in the foregoing can be obtained from commercial chemists, who would doubtless also be prepared to furnish complete information regarding the mixing and application of this enamel.

Cleveland, Ohio D. C. OVIATT

* * *

Figures available from official Soviet sources published in Moscow show that the cotton-spinning industries in Russia during the first six months of 1920 turned out 2 per cent of the 1914 production.

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

FINDING ANGLE OF SPRING CLAMP

J. O.—Referring to Fig. 1, will you please show how to find angle ϕ? This dimension is required in laying out a perforating, embossing, and cutting-off die for producing a spring clamp. Fig. 1 shows a side view of the clamp.

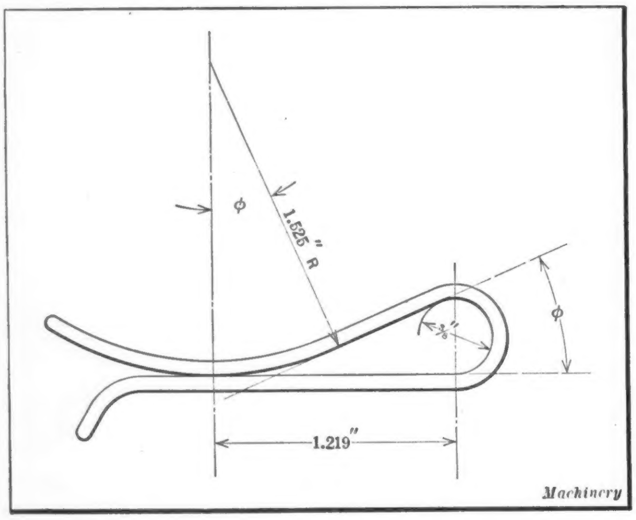


Fig. 1. Side View of Spring Clamp

A.—First construct the diagram shown in Fig. 2, making $c = 1.219$ inches, $R = 1.525$ inches, and $r = 3/16$ inch. From the right triangle AOB, it will be seen that

$$\operatorname{Tan} a = \frac{R - r}{c} \quad (1) \text{ and } h = \frac{R - r}{\sin a} \quad (2)$$

From the right triangle AOE,

$$h = \frac{R + r}{\sin (\phi + a)} \quad (3)$$

From (2) and (3) by comparison,

$$\operatorname{Sin} (\phi + a) = \frac{R + r}{R - r} \sin a \quad (4)$$

Inserting numerical values in (1), we find

$a = 47$ degrees 39 minutes 14 seconds

Then from (4) we find

$\phi + a = 71$ degrees 8 minutes 23 seconds

$\phi = 71$ deg. 8 min. 23 sec. — 47 deg. 39 min. 14 sec.
= 23 degrees 29 minutes 9 seconds. W. W. J.

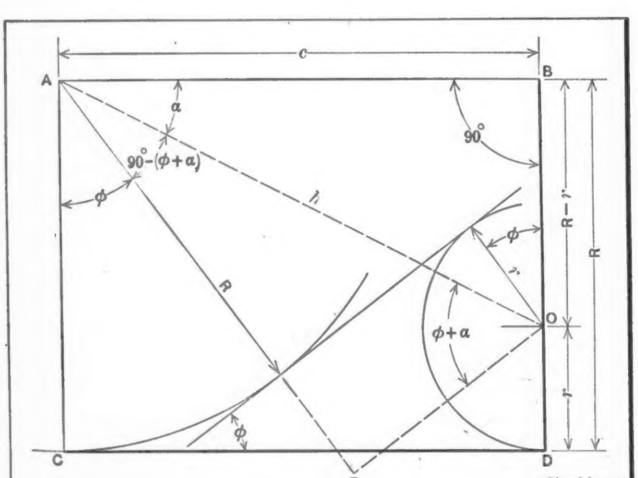


Fig. 2. Diagram illustrating Method of finding ϕ Fig. 1

FINDING THE LENGTHS OF TWO SIDES OF A TRIANGLE

B. I. H.—Referring to the accompanying illustration, lines $a + b = 150$ inches, $o = 30$ inches and $c = 50$ inches. How can the length of sides a and b be determined?

A.—The easiest method of solving this problem is to assume approximately correct values for lines a and b, then determine the magnitude of angle C for the assumed value of line a, and finally determine the length of line c with the assumed values of lines a and b. After a few trial calculations are made in the manner suggested, the exact value of line a can be obtained by interpolation, as explained in the following.

If the diagram illustrated is laid out to scale, it will be found that the length of line a is approximately 57 inches, and that of line b, 93 inches. Assuming these values to be correct, it is obvious that $\tan C = \frac{30}{57}$ and $C = 27$ degrees 45 minutes 31 seconds. Then, the length of line c can be calculated by means of the well-known trigonometrical formula for finding the length of a side of an oblique-angled triangle,

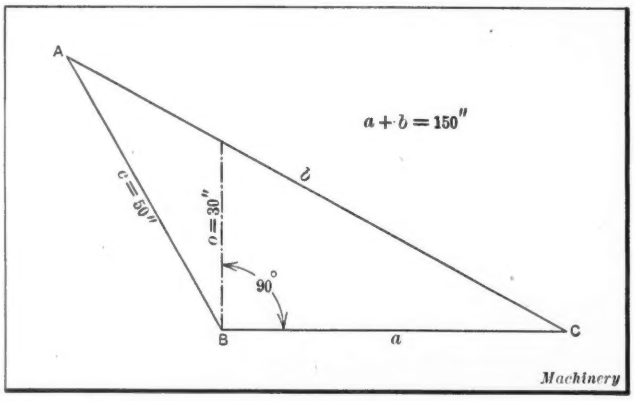


Diagram of Problem to find the Lengths of Sides a and b

when two sides and the included angle are known. This formula is given in MACHINERY'S HANDBOOK on page 152 as follows:

$$c = \sqrt{a^2 + b^2 - 2ab \cos C}$$

By inserting the assumed values in this formula, and solving, it will be found that the length of line a will be 50.1607 inches. Thus, the error from the true value equals 50.1607 — 50 or 0.1607 inch.

Now, assuming line a to be 57.1 inches long and the length of line b to be 92.9 inches, angle C will be 27 degrees 43 minutes 2 seconds. Again calculating side c by means of the formula, it will be found to equal 49.9900 inches. In this case there is an error equal to 50 — 49.9900 or — 0.0100 inch. The difference between the two errors equals 0.1607 — (—0.0100) or 0.1707 inch. The length of side a that will give an error of zero when calculating side c by means of the formula, can be determined by interpolating as follows:

$$57 + \frac{1607}{1707} \times 0.1 = 57.094 \text{ inches}$$

This gives the correct value of line a to the third decimal place. The value of line b, of course, equals 150 — 57.094 or 92.906 inches. If greater accuracy is required, repeat the computation with the last value found for side a and interpolate again. W. W. J.

Industrial Conditions in France, Holland and Italy

Special Correspondence to MACHINERY

Paris, April 4

CONDITIONS in France do not seem to improve very rapidly. Now and then a factory reports that its business is improving somewhat, and additional men are hired, but the improvement does not appear to be permanent. The Hispano-Suiza Automobile Co. was working two shifts on my last visit, but I do not understand where all the cars made are sold, for the price is 78,000 francs for the bare chassis. At the Citroën plant about a month ago they were building about thirty cars a day, many of which were for export. Most of the other automobile concerns are working about forty-eight hours a week, but with a smaller number of men than when they are working to capacity.

The works La Sté Alsacienne des Constructions Mecaniques, in Grafenstaden, Alsace, have received a big order for locomotives for the French railroads. This contract is practically completed, and whether or not they will receive an additional contract is not yet known. In Lille, the Fives-Lille Co. is quite busy on railroad material, and some other factories in the same city are fairly busy building and repairing textile machinery.

I am rather inclined to be pessimistic about the immediate future of France, and do not see how she can get into motion again without quite a large amount of money; and with Germany refusing to pay I do not see how she will be able to get on her feet without borrowing money, although she has about all the debts that she can stand up under now. I do not expect to see the value of the franc come up to less than ten to the dollar for a good many years.

Conditions in Holland

I have just spent two weeks in Holland where the majority of the machine shops are engaged in shipbuilding and repairing, but they are not very active just now. The Dutch complain of an exchange unfavorable to them by 17 per cent, but I pointed out that they were fortunate as compared with France, Belgium, and Italy, where the exchange was unfavorable by 300 per cent or more.

There is a great number of bicycles to be found in Holland, but most of them are imported. I saw some good looking bicycles at $20 of German make. The Trompenburg Co. at Amsterdam builds the Spyker automobile. It is a very fine looking six-cylinder car, but only 500 or 600 of these cars are built a year when business is good, and at present the company is doing next to nothing. It has in its show-room a six-cylinder car built, I believe, in 1902, which is claimed to be the first six-cylinder car in the world. The cylinders were all cast separately, so that the hood is very long.

I have found no one anywhere who is willing to make any prophesy as to when business in France, Belgium, and Holland will be better. Of course, everyone hopes that it will be better in a few months, but it is difficult to see any good foundation for this belief.

The French Machine Tool Trade

Paris, April 12

The market for machine tools has slightly improved. Some dealers in American machine tools who have accepted 10 francs for a dollar have been able to sell a number of machines. One dealer reports sales amounting to 500,000 francs in one month and another, sales of 1,000,000 francs.

After the armistice, French manufacturers of machine tools expected that they would find a big market for their product in the devastated portions of France. Their building programs were discussed with Le Comptoir Central D'Achats, a bureau having in charge the rehabilitation of the devastated regions. It appeared quite certain that much machinery and building material would be required. Ultimately, however, these requirements were filled to a large extent by machines bought from Germany, in addition to many important orders which were placed in the United States for machines which later became very expensive on account of the exchange.

The "Comptoir" has not disposed of all the machines that it ordered from Germany and the United States, but finds its warehouses filled with stocks, and being in need of funds has begun to bring pressure to bear on the manufacturers of the devastated districts in order that these may give preference to the machines that the "Comptoir" has in stock. Manufacturers who require only very simple machine tools for intermittent work, say, for example, simple milling, find themselves asked to accept a universal milling machine at a very high price which does not at all suit the needs of their shop. In some cases, the manufacturers have had to buy machines entirely too complicated for their needs from the "Comptoir."

Many of the large French shops and state arsenals have begun to manufacture machine tools, and are thus coming into competition with the regular manufacturers at the critical period that the country is now passing through. Furthermore, it is feared that the machines produced by the firms mentioned will be inferior to those manufactured by the regular machine tool builders.

Employment in French Industries

The number of working hours per week has been reduced in many districts. One of the large steel plants is working only sixteen hours per week. In the nut and bolt business, a six-hour day prevails and wage reductions have taken place. In some cases such reductions have caused strikes, in others the reductions have been accepted without controversy. The workmen understand thoroughly the seriousness of present conditions. The labor unions no longer seem to have as great an influence as in the past upon the general opinion of labor.

Several new companies have started in business even at this time. Among the most important may be mentioned Compagnie Generale de Construction de Locomotives, which has built a factory at Nantes. It is expected that this plant will turn out ten locomotives per month at first, and this output will be increased later. It is also expected that a certain number of locomotives per month will be repaired at the plant. The equipment and arrangement of the plant are the most modern, and ultimately the plant may employ 30,000 workers. A village of 450 houses has been built for the workmen so far.

Societe d'Outillage Mecanique & D'Usinage d'Artiellerie is now making machine tools, power presses, hydraulic presses, farm tractors, etc., in addition to war materials.

In the machine tool field, this firm is planning on quantity production. The same policy will be followed in regard to tractor manufacture. In spite of the crisis which the French industry is passing through, it is stated that the orders received by this company have been very satisfactory. The Bulgarian state railways are in the market for twenty-five locomotives and a number of freight cars.

Conditions of Italian Industry

The Italian industry has undergone a change that is very interesting to note. The low exchange of Italy has in some ways proved a stimulus to its economic development. The steel mills and steel foundries have shown considerable activity and progress. At the recent fair at Milan there were exhibited truck tires, parts of agricultural machinery, pulleys, etc., made of steel castings that were remarkably uniform and homogeneous. Some of these steel castings appeared to be fully satisfactory for use where forgings have been employed in the past.

During the war, numerous electric furnaces were installed in all the large foundries, and molding machinery was substituted for hand molding. For this reason, there are a number of important iron and steel foundries capable of a large output. On the other hand, the forging industry has not seen any remarkable progress, although there has been some development in the drop-forging field, and there are numerous shops that compete with foreign products in this line.

Italy has even entered the export trade in machinery, having exported some lathes, milling machines, and drilling machines; but Italian builders of machine tools do not seem to have entered the field of high-class precision machinery. It appears to an observer that the machine shop industries in Italy have acquired an unexpected power and strength, and that they are likely to have a prosperous future. This optimistic belief is due to the fact that satisfactory products have not been turned out by only a few large plants, but by a number of medium-sized and small plants.

What will happen when the extraordinary requirements that now exist have passed and when conditions again become normal and general competition governs business activity is difficult to say. Then the question of production costs will again become important, and it is difficult to see how manufacturers not building in large quantities will be able to compete with those who can advantageously devote themselves to quantity production. Large factories are not as frequently seen in Italy as in the other leading European countries, and it is doubtful if the smaller factories, upon which all efforts now seem to concentrate, will be able to retain their present position when conditions of business again become normal.

* * *

SOUTH AMERICAN TRADE

Even before the European war the United States was rapidly making inroads into the long entrenched foreign business in most of the Latin-American countries in machinery and related supplies. During the war period and the resultant almost complete cutting off of the European supplies, the more enterprising American manufacturers were able to increase their advantage greatly. At the present time it is largely a question of retaining their hold against the reviving competition from Germany, England, Belgium, and France.

America's greatest handicap in all the Latin-American territory lies in the fact that most of the men in charge of the operations where machinery of any kind is used are of European nativity or ancestry. Naturally they favor the machinery made in their respective countries; and in cases of English, German, or French control of the companies, their orders invariably go to home country manufacturers. The few exceptions usually prove to be where an American product of unquestionably superior merit is available.

Importance of Selecting the Right Kind of Dealer

It is important for American manufacturers to give careful consideration to the choice of their Latin-American dealers. There is an inclination among these dealers to look upon their American connections as merely side lines. Most of them have been handling European machinery for years; they are familiar with it and with the trade. Their relations have been for the most part agreeable; and it is characteristic of the Latin-American to let well enough alone. Many an American company has found that the dealer took on its line largely as a matter of self-protection and with no definite idea of pushing it aggressively. The American manufacturer's first important step is to assure himself that he is securing an active agent.

South American Demand for Machinery

Generally speaking, the machine shops of South America are behind the times. There are usually two or three that stand preeminently above their competitors in size and equipment. Some of these are equipped almost entirely with American machinery. The railroad shops are perhaps the most efficiently equipped, and in this statement the electric railroads are included. Electrical development has been particularly progressive.

The extensive mining operations afford a constantly increasing demand, and American mining machinery is growing more and more in favor. With the electrical development, American superiority is generally recognized, but there is frequently difficulty in overcoming the influence of foreign invested capital in these projects; this is a condition that must be taken into consideration in every line and in every quarter.

Probably the greatest success has been scored by those concerns, particularly in agricultural machinery, who have established their own branch sales departments and have on the ground constantly an alert sales force which keeps closely in touch with conditions, development, and demand. This in fact is by far the best solution, and with a greater degree of cooperation among manufacturers of non-competing lines, whereby the expense of such a distribution depot could be jointly met, excellent results should be accomplished. Lately there is also a growing furniture manufacturing interest, particularly in Brazil. Here there is a promising and profitable market for American woodworking machinery. This interest is also advancing in Argentina, and to a less degree in Chile. In several states, during the last few years, there has been a rather keen development in the textile industry. Recently increasing activity in the development of the Colombian oil fields affords a demand for all the machinery and apparatus necessary in this line of work.

Coming Foreign Trade Convention

Machinery manufacturers generally will doubtless profit greatly from the discussions at the Cleveland convention, May 4 to 7, of the National Foreign Trade Council, where the leaders of the export business will get together for one of the most comprehensive reviews of the foreign trade situation that has ever been held in the United States. American industry, today, as never before, appreciates what an extensive and permanent foreign demand means to industrial production. This convention will attract the leaders of every line of American manufacturing—men familiar, through long years of application, with the various foreign fields. There will be special sessions arranged for various industrial groups, in addition to the regular program, so that each line may have ample opportunity to consider its own peculiar problems and outline a cooperative effort toward their solution.

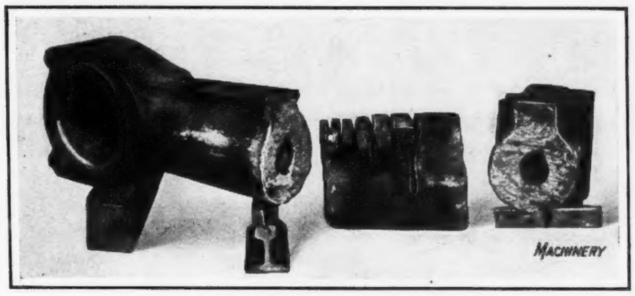


Fig. 1. Crank-arm with Section cut out by Oxy-acetylene Torch

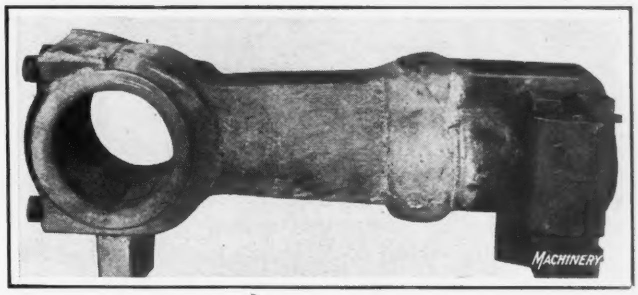


Fig. 2. Crank-arm after being welded by Thermit Process

SHORTENING A PRESS CRANK-ARM

It was recently found necessary in the plant of the New Jersey Tube Co., Harrison, N. J., to equip a drawing press with a crank-arm 18 inches shorter than the one with which the press was provided. This crank was of cast iron and of the hollow cylindrical type, the outside diameter of the cylindrical part being 18 inches. Instead of buying a new crank-arm which would have cost from $350 to $400, the company saved from $200 to $250 by removing the crank-arm from the machine, cutting an 18-inch section out of the crank by means of an oxy-acetylene torch, lining up the two sections in a horizontal position, and then welding the end sections together by the thermit welding process, which cost only $150. The crank with the piece cut out is shown in Fig. 1 as it appeared before welding, and in Fig. 2 as it appeared after the weld had been made.

* * *

EXTERNAL BROACHING ON WRENCH JAWS

On page 501 of the January number of MACHINERY, was described and illustrated equipment used in performing some interesting broaching work on an adjustable jaw wrench. The present article deals with additional broaching work on the adjustable wrench, the part to be broached being the jaw, which is shown in detail in Fig. 1. It will be noted that the jaws have a cylindrical body, 0.305 to 0.308 inch in diameter, and a connecting web to the main part of the forging. All these surfaces are externally broached, the equipment illustrated in Figs. 2 and 3 being used. It is required to remove from the forging from 0.006 to 0.008 inch of metal on the cylindrical and connecting portions, and on the adjacent surface of the jaw proper there is approximately 1/32 inch of metal to be removed.

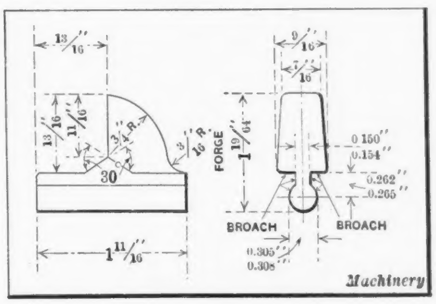


Fig. 1. Wrench Jaw broached on Machine shown in Figs. 2 and 3

In broaching these adjustable wrench jaws, the smaller size broaching machine made by the American Broach & Machine Co., Ann Arbor, Mich., was employed, equipped with a fixture of very simple design. In Fig. 2 the work is shown located in the fixture, between the two broaches, at the beginning of the stroke. The forging is merely dropped in between the two broaches and locates itself in the fixture without auxiliary means. A better view of the fixture and the contour of the edge of the teeth in the broaches, can be obtained from Fig. 3. It will be evident that there are provided merely a seat and a backing for the forging, and that the broaches work close together and thereby enclose the cylindrical part of the forging to the extent required in removing the desired amount of metal. The time required to finish one of these wrench jaws is ten seconds.

* * *

The American Foundrymen's Association has appointed a committee to act in an advisory capacity to the United States Bureau of Standards, with a view to making investigations and promulgating standards for foundry practice.

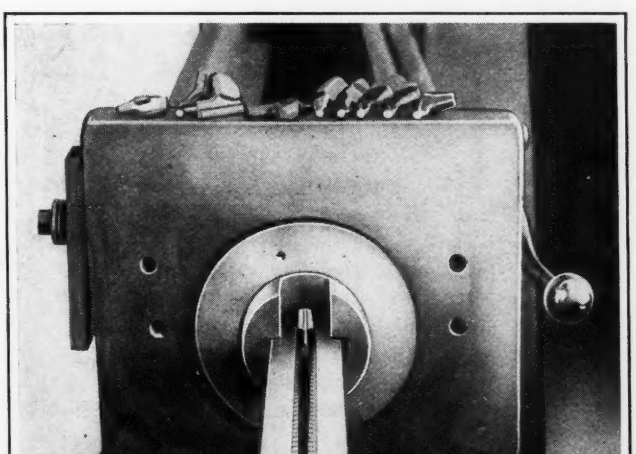


Fig. 2. Broaching Machine with Jaw in Place, before Beginning of Cut

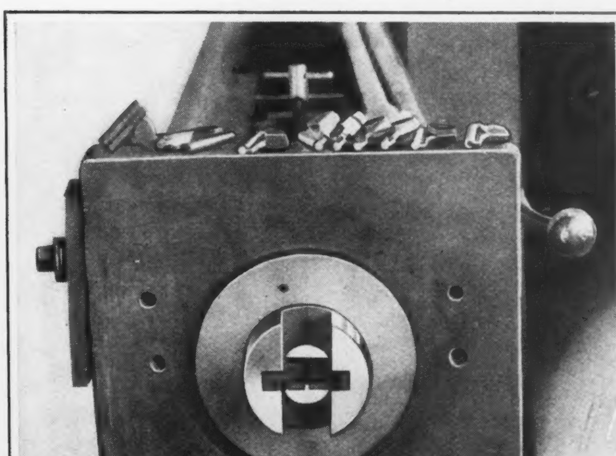


Fig. 3. Broaching Machine at Completion of Cut, with Work removed

CONVENTION NEWS

ANNUAL MEETING OF THE AMERICAN WELDING SOCIETY

The American Welding Society, 33 W. 39th St., New York City, held its annual meeting April 27 to 30 in the Engineering Societies Building, New York City. During the first meeting day, the committees on gas welding, resistance welding, welding wire specifications, and the so-called "welding conference committee" made their reports. The following day the committee on specifications for steel to be welded made its report, and the business session of the society was held. At the technical session, which was held on the evening of the second day, papers were presented on "Applications of the Automatic Welding Machine," by P. O. Noble; "Production Welding with the Gas Flame"; and "Results of Recent Thermit Welding Research," by J. H. Deppeler. This last paper dealt with the standardization of thermit welding practice, the cost and method of elimination of defects in thermit welds, blow-holes, shrinkage cavities, etc. The committees on electric arc welding, welding of storage tanks, and training of operators made their reports during the last two days of the meeting.

AMERICAN GEAR MANUFACTURERS' CONVENTION

The fifth annual meeting of the American Gear Manufacturers' Association was held in Cincinnati, Ohio, April 27 to 30, the headquarters being at the Hotel Sinton. The program of the meeting included an address of welcome by Hon. John Galvin, mayor of Cincinnati; an address by the president, F. W. Sinram; and addresses by J. B. Doan, president of the American Tool Works Co.; G. M. Bartlett of the Diamond Chain & Mfg. Co.; Hon. George Wilder Cartwright, Senator from California; Edward S. Jordon, president of the Jordon Motor Car Co.; Charles Woodward, vice-president in charge of personnel of the Hydraulic Steel Co.; A. R. Mitchell of the Andrews Steel Co.; and J. B. Foote, president of Foote Bros. Gear & Machine Co.

Reports were presented by various committees including the Commercial Standardization Committee, C. E. Crofoot, chairman; Committee on Worms, Worm-gears and Spirals, J. C. O'Brien, chairman; Inspection Committee, E. J. Frost, chairman; Sprocket Committee, C. R. Weiss, chairman; Hardening and Heat-treating Committee, C. B. Hamilton, chairman; Composition Gearing Committee, John Christensen, chairman; Herringbone Gear Committee, A. F. Cooke, chairman; Committee on Gears and Pinions—Electrical Railway and Mine, W. H. Phillips, chairman; Keyway Committee, Henry J. Eberhardt, chairman. On the last day of the convention there was an interesting discussion on the subject of testing and inspecting large and medium size industrial gears. A more complete report of the meeting will be given in June MACHINERY.

CONVENTION OF THE NATIONAL METAL TRADES ASSOCIATION

On April 20 and 21, the twenty-third annual convention of the National Metal Trades Association was held at the Hotel Astor, New York City. The first meeting was convened at 9:30, and after the usual preliminaries, reports were read by President Albert E. Newton, Treasurer Frank C. Caldwell, Commissioner John D. Hibbard, and Secretary Homer D. Sayre. Following these came the report of the Committee on Industrial Education read by its chairman, Harold C. Smith of the Illinois Tool Works, Chicago, Ill. William S. Kies of Aldred & Co., New York City, then addressed the convention on "Economic Conditions in Europe and How They Affect Us." Mr. Kies called attention to the fact that America's industrial prosperity is largely dependent upon the re-establishment of normal conditions in Europe. He emphasized the importance of adopting an aggressive and liberal policy in developing export trade.

A. T. Simonds of the Simonds Mfg. Co., Fitchburg, Mass., opened the afternoon session with an address entitled "Quit Deceiving Yourself." Mr. Simonds prefaced his discussion with a statement that for years the study of economics had been one of his favorite hobbies, and he went on to say how greatly a comprehensive knowledge of this subject had helped in the management of his business. M. W. Alexander, managing director of the National Industrial Conference Board, New York City, followed Mr. Simonds with a discussion of "Timely Industrial Problems." His address dealt with factors which affect the wages paid to industrial employes and was illustrated by charts. The Hon. Charles L. Underhill, Member of Congress, Somerville, Mass., addressed the convention on the subject of "Labor Unions in Time of War."

The Thursday morning session was called to order at 9 o'clock and was addressed by the Rev. E. Victor Bigelow, Andover, Mass., on "Mistakes of the Inter-Church Steel Report." Following this address came a discussion of practical methods of industrial training. This included the annual report of Philip C. Molter, superintendent of the Department of Industrial Training of the National Metal Trades Association, and addresses entitled "Our Experience with Training," by George A. Seyler, works manager of the Lunkenheimer Co., Cincinnati, Ohio; "Modernized Apprenticeships," by J. E. Goss, supervisor of apprentices, Brown & Sharpe Mfg. Co., Providence, R. I.; and "Recent Developments in Training Instructor Foremen and Plant Leaders," by D. J. MacDonald, professor of vocational education, University of Cincinnati, Cincinnati, Ohio.

The officers of the association for the coming year will be: President, Albert E. Newton, Hobbs Mfg. Co., Worcester, Mass.; first vice-president, George O. Rockwood, the Rockwood Mfg. Co., Indianapolis, Ind.; second vice-president, W. W. Coleman, Bucyrus Co., South Milwaukee, Wis.; treasurer, F. C. Caldwell, H. W. Caldwell & Son Co., Chicago, Ill. These men were all re-elected to the offices which they held for the year 1920-1921. Justus H. Schwacke, William Sellers & Co., Inc., Philadelphia, Pa., was elected an honorary counsellor in recognition of the able service which he has rendered to the association over a long period of years.

* * *

TESTS FOR COLLEGE STUDENTS

The Dartmouth College has instituted a new system of tests for undergraduates, having recognized in common with a number of other colleges the fact that a student's scholarship is not necessarily an accurate indication of his ability to cope with the difficulties of his profession. These tests are general and personal, but are not like the psychological tests which certain other colleges have been giving. Under this system the instructors rate each of their students, using the regular letter scale (A, B, C, D, E, with A the highest), under the following headings:

1. Intelligence—Ability to grasp a situation, alertness of mind. (Not to be confused with scholarship.)
2. Aggressiveness—Personal force, initiative, assurance, decisiveness.
3. Reliability—Dependability, sense of responsibility, perseverance, attentiveness, punctuality.
4. Personality—Bearing, neatness, courtesy, personal acceptability.

Nearly every man in the college was rated by one or more instructors, about 1500 being rated by from three to five. It was found that four men in every five created almost exactly the same impression upon all their judges. Since the agreement was so great and the facts valuable, the plan will be continued this year.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

The New Tool Descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

Alfred Herbert Thread-cutting Lathe

THE production of thread gages with any style of thread may be accurately accomplished on a precision lathe recently developed by Alfred Herbert, Ltd., Coventry, England, who maintains a branch office at 54 Dey St., New York City. A general view of the machine is shown in Fig. 1, from which it will be seen that the bed is of box section and rests on three ball feet secured to the base in such a manner as to allow the bed to expand and contract with changes of temperature. This construction and mounting of the bed eliminates warping, springing, and vibration.

The headstock is provided with a three-step cone pulley, on the shaft of which there is mounted a pinion that meshes with teeth on the periphery of the driving plate to rotate this member. The left-hand end of the driving plate spindle is provided with a pinion that drives the lead-screw through a train of change-gears. The work-center does not revolve. The tailstock is provided with a fine adjustment across the bed so as to maintain the alignment of centers. The sleeve that carries the tailstock center is clamped in position through the operation of a handle, and it is prevented from turning through the employment of a suitable device.

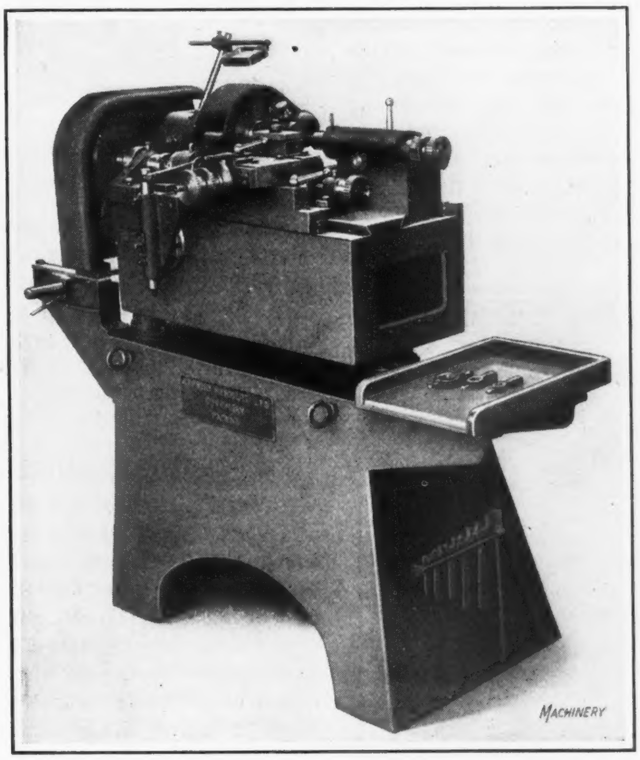


Fig. 1. Lathe for cutting Thread Gages, which is built by Alfred Herbert, Ltd.

Construction of the Saddle

From Fig. 2 it will be seen that the saddle is of ample length to obviate any tendency to lift or twist. There are two slides on the saddle, a top slide and an intermediate one. The tool is held in an eccentric bushing on the top slide, the eccentricity of the bushing allowing the tool to be adjusted to the correct height. A micrometer dial reading to 0.0001 inch is provided to enable the tool to be fed accurately to the correct depth of cut. A nut on this feeding mechanism is adjustable to compensate for wear of the micrometer screw. The intermediate slide has a longitudinal micrometer adjustment for setting the tool relative to the required length of the work, and it is then locked in position by means of a handle. A gear segment actuated by a lever and meshing with a rack on the top slide is furnished on the intermediate slide for the purpose of withdrawing the tool quickly when reversing, or bringing it rapidly up to the work.

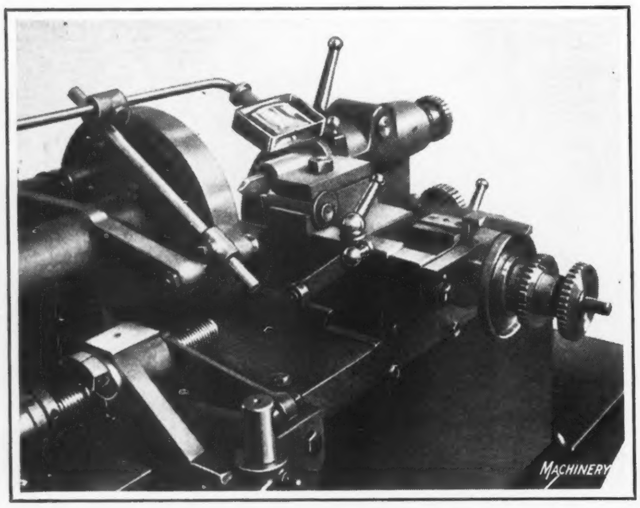


Fig. 2. Construction of Saddle, and Method of attaching it to Lead-screw

Accuracy of the Lead-screw

The lead-screw is located above and between the V-guides of the saddle, as shown in Fig. 3. In order to insure the accuracy of this important member, the lead-screw is cut on a lathe which is provided with a lead-screw correct over its entire length of 24 inches to within 0.0002 inch. The lead-screw of the Alfred Herbert precision thread-cutting lathe is 6 inches long and has eight square threads per inch. The thrust on the lead-screw is taken by a bracket doweled to the top of the bed at the left-hand end. Instead of the usual split nut, a solid phosphor-bronze nut is used for transmitting motion to the saddle. The threads are cut in a renewable white-metal lining cast in the nut opening.

Pitch-varying Attachment

In the production of thread gages, it is necessary to make certain allowances to compensate for shrinkage or elongation of the part during the hardening process. The proper allowances can be readily made on this machine by means of the pitch-varying attachment illustrated in Figs. 3 and 4. The desired result is obtained by rotating the lead-screw nut with a uniform motion independent of that of the lead-screw. If the rotation of the nut is opposite to that of the lead-screw, the pitch of the thread being cut will be longer than would be obtained if the nut were stationary. This increase in the pitch will be greater as the amount of movement of the nut relative to the screw per revolution of the lead-screw is increased. If the nut revolves in the same direction as the lead-screw, the conditions will be reversed, and the pitch of the thread which is being cut will be shortened. Very little time is required to make the adjustment necessary to lengthen or shorten the pitch of a thread.

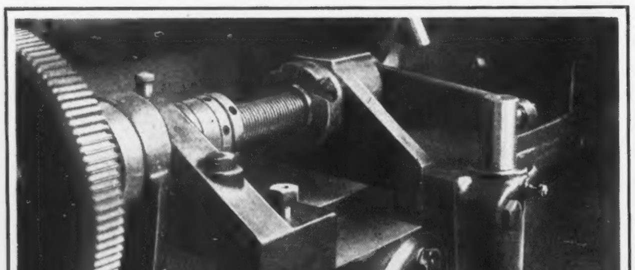


Fig. 3. Attachment for increasing or decreasing Pitch of Screw

Referring to Fig. 4, it will be seen that the attachment consists mainly of a bracket *A* attached to the saddle and carrying a plunger *B* which is provided with a hardened steel plug *C*. One end of this plug travels in a slot formed by two strips *D* (see Fig. 3) which are made of hardened steel and fastened to disk *E* attached to the bed of the lathe. This disk can be swiveled either way to give the plug slot the required amount and direction of inclination. A small portion of the disk edge is graduated, each graduation indicating an increase or decrease in the lead of the thread being cut, of 0.0001 inch per inch of the lead-screw length. The lead-screw nut has a projecting arm *F* which is provided at the outer end with a hardened pin that engages a slot cut horizontally across the upper end of plunger *B*. As the plunger is raised or lowered, according to the slope of the central slot, when the saddle is traversed, the speed of the saddle is increased or retarded, as the case may be, relative to the motion of the lead-screw.

Special Jig for Grinding Tools

In the cutting of threads, many of the errors are due to the use of an improperly ground tool. To eliminate this source of error, a specially designed fixture is furnished

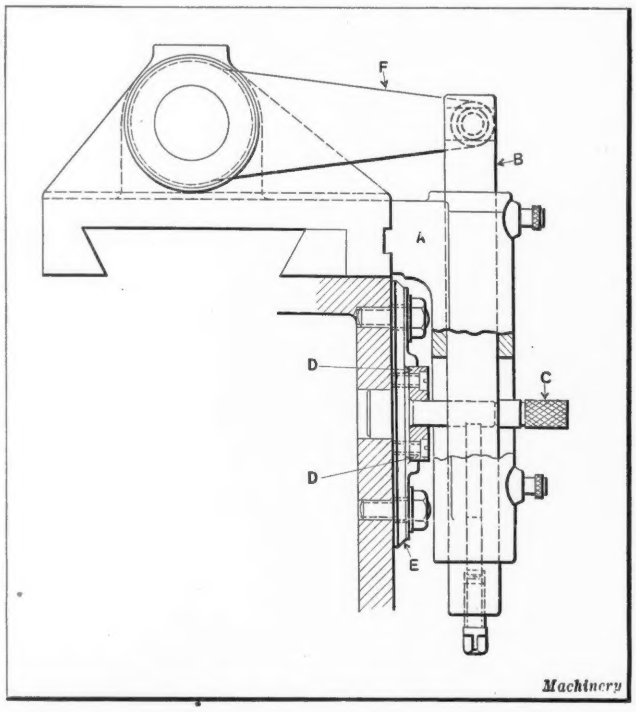


Fig. 4. Pitch-varying Attachment shown diagrammatically

with the machine, which permits tools to be readily ground to the desired angles. The machine described in the foregoing has a capacity for work up to 2½ inches in diameter, will hold work from 3 to 6 inches in length, and will cut threads to a length of 3 inches. One horsepower is required for driving the machine, and its weight is approximately 1600 pounds.

WHIPP 12-INCH CRANK SHAPER

In the June, 1920, number of MACHINERY was published a description of 16-inch single-geared and 20-inch back-geared crank shapers then placed on the market by the Whipp Machine Tool Co., Sidney, Ohio. This concern has now developed a 12-inch single-geared crank shaper which is of essentially the same design as those dealt with in the article mentioned. On the new machine the maximum length of stroke is 14 inches; the horizontal travel of the table, 18 inches; the vertical travel of the table, 14 inches; the maximum distance from the table to the ram, 16 inches; the keyseating capacity, for shafts up to 2½ inches in diameter; and the maximum opening of the vise jaws, 8 inches.

MORTON RAILROAD SHAPER

The special heavy-duty draw-cut railroad shaper here illustrated was developed by the Morton Mfg. Co., Muskegon Heights, Mich., primarily for the machining of driving-boxes, crown brasses, shoes and wedges, connecting-rod brasses, etc. However, it may be employed for the performance of various classes of work. The column is a heavy box-section casting provided with square bearings for the cross-rail. The latter is raised and lowered by screws, and can be clamped in position. A counterweight is furnished for the cross-rail on account of the weight of special attachments that are used on this machine. The saddle is fitted to square rail bearings on the cross-rail. Two sides of the table are provided with T-slots, the upper one furnishing a bolting surface for the vise, top table, and attachments. An angular extension bolts to the other T-slotted surface to facilitate the clamping of driving-boxes when machining the shoe and wedge fit.

The vise is so constructed that the cutting strains are transferred through the solid vise jaw to a back-bearing and the collar. Two screws control the motion of the sliding jaw. The stationary jaw has parallel planed ends which

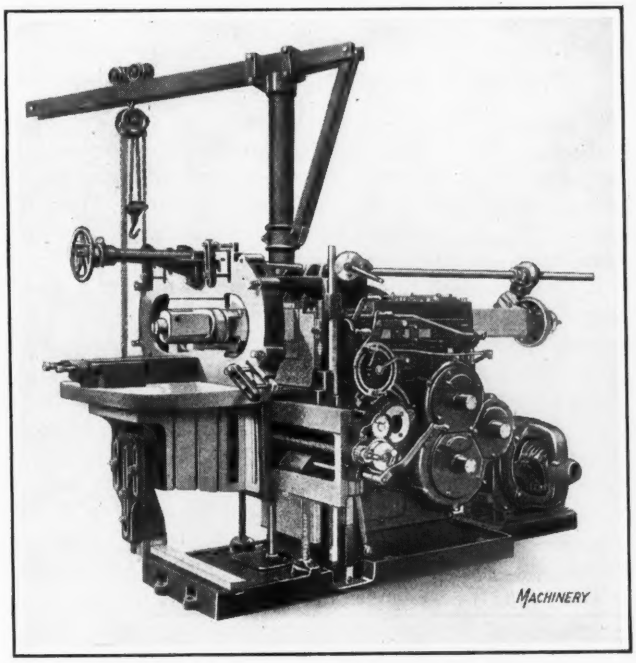


Fig. 1. Heavy-duty Draw-cut Railroad Shaper which is a Product of the Morton Mfg. Co.

can be set snugly against the adjustable back-bearing. The base of the vise is graduated through 180 degrees. The adjustable back-bearing is mounted on a post bolted to the cross-rail. It may be moved vertically to the desired position or swung to one side and out of the way when using special attachments. An auxiliary back-bearing is bolted to the top of the machine for transferring the thrust of the cut to the column when using the driving-box attachment furnished as regular equipment.

The ram is hollow and has a bearing surface on all four sides throughout the length of the column, except for a small space at the center where the rack is lubricated. The ram is bored at each end to receive an arbor. A rotating arbor gives the circular feed to the rotating head for cutting the crown fit in driving-boxes, the head being mounted on the front of the arbor. The rotary feed of the latter is obtained from the regular automatic feed by means of a gear and ratchet working in connection with a vertical rack. The rotary motion is transmitted through a splined shaft and gears to the arbor, which may be fed automatically in either direction. The shaper head is graduated and may be set at any angle by means of a suitable clamping device.

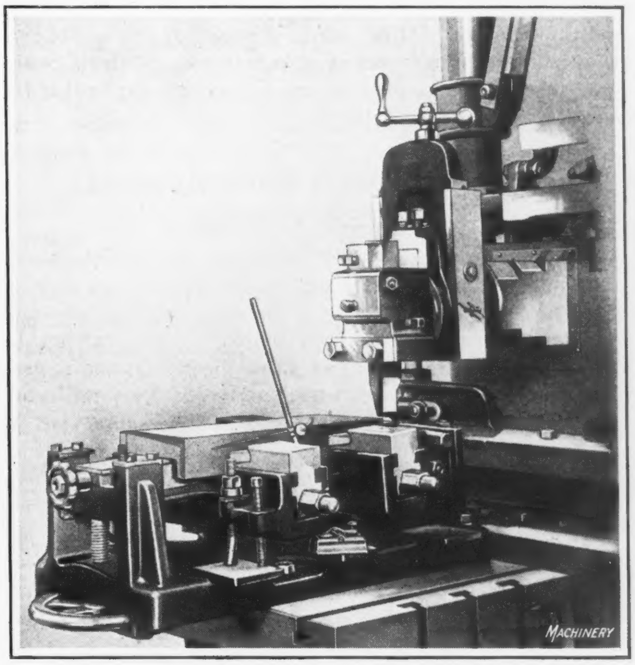


Fig. 2. Special Attachment used in machining Wedges

The reciprocating motion of the ram is obtained by the use of compound disk friction clutches. A simple shifting bar and revolving cam reverse the clutches for the return stroke. The machine can be started and stopped by a clutch independent of the driving motor, and the ram can be moved as little as 1/16 inch if desired. The ram stroke is adjusted by tappets on a circular disk and can be altered while the machine is in operation.

A rapid power traverse is provided for raising and lowering the cross-rail and moving the saddle sidewise in either direction. Any horizontal or vertical feed within a wide range is obtained quickly by setting tappets on a disk. A belt-driven machine is furnished with a two-speed countershaft. A motor drive for either direct or alternating current can be furnished. The crane and hoist are furnished as regular equipment to facilitate the handling of the vise, attachments, and work that is too heavy to be loaded and unloaded by hand. Some of the special attachments which may be furnished are as follows: Shell or crown brass planing attachment, driving-box shoe and wedge planing attach-

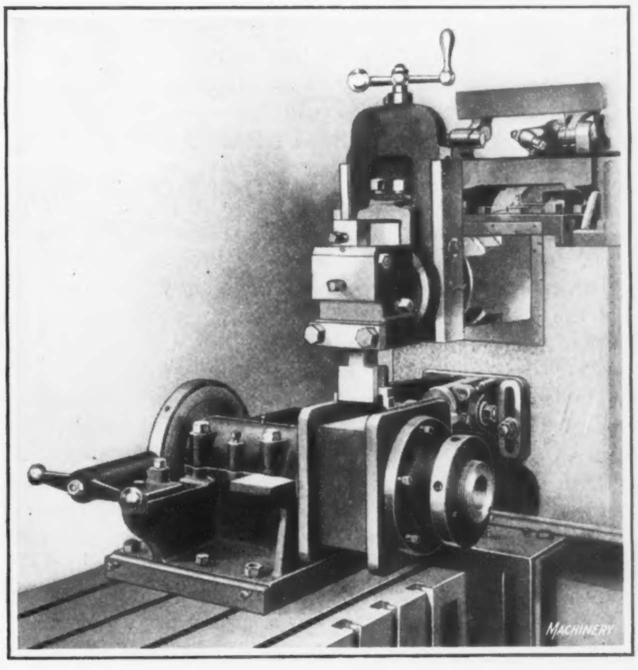
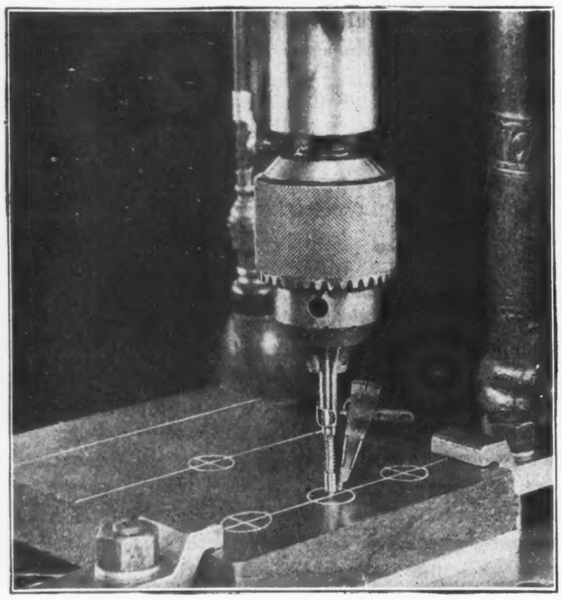


Fig. 3. Attachment employed in machining Connecting-rod Brasses

ment, connecting-rod brass planing attachment, small rotary head, and double cutting head. The driving-box shoe and wedge planing attachment is shown in use in Fig. 2, while Fig. 3 shows the method of employing the connecting-rod brass planing attachment.

JOHNSON & MILLER UNIVERSAL CENTER-TESTER

The illustration shows an "Ideal" universal center-tester being employed in locating a prick-punch mark on a piece of work, central with the spindle of a drilling machine. This device has recently been placed on the market by Johnson & Miller, 42 Murray St., New York City, and is used in connection with their "Ideal" universal test indicator. When employing the tester as shown, the center rod is placed on the prick-punch mark. Then, as the spindle of the machine is rotated, if the prick-punch mark is not central with the machine spindle, this condition will be apparent, due to the indicator contact point tracing an eccentric circle about the center rod. The work is then shifted until the contact point of the indicator rotates on the center rod without causing deflection of the indicator needle. This



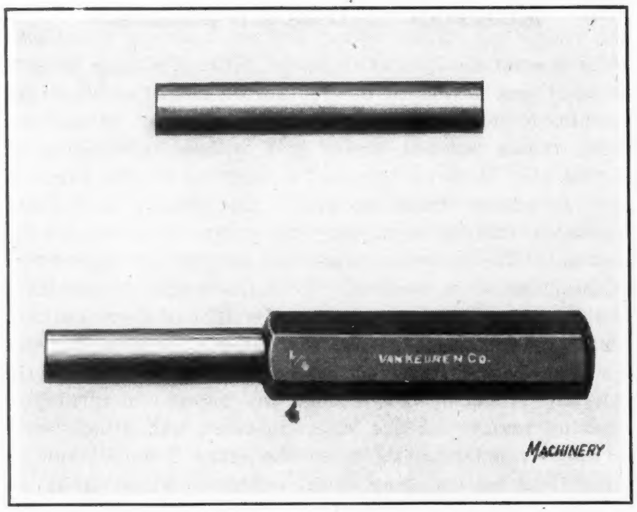
Use of the "Ideal" Center-tester sold by Johnson & Miller

tester may also be used to locate a prick-punch mark central with the spindles of milling and boring machines, for truing up marks on work on the faceplate of lathes, etc.

VAN KEUREN PLUG GAGES

A line of precision plug gages of unusually simple construction has recently been placed on the market by the Van Keuren Co., 362 Cambridge St., Allston Station, Boston, Mass. One of these gages is shown in the accompanying illustration, the lapped cylinder being shown at the top, and the cylinder inserted in the hexagonal handle, at the bottom. The cylinder is placed in the handle for about one-third its length and cemented therein with shellac. It is stated that by this method the two parts are held so securely together that if the plug is clamped between the jaws of a vise and a wrench applied to the handle, the plug will not become loosened. However, in order that both ends of the plug may be used, the plug may be readily removed from the handle when the exposed end is worn, after heating the handle in a flame to about the temperature of boiling water. The worn end is then secured in the handle.

It is claimed that by means of a special process of manufacture, an extremely accurate plug is obtained. A ¼-inch plug tested by the Bureau of Standards was only out of round two millionths inch; at the middle it was within

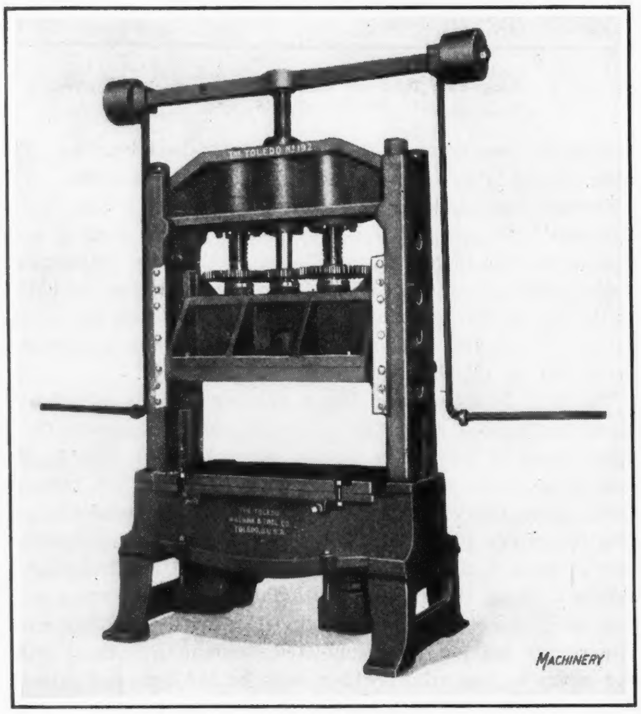


Reversible-end Plug Gage made by the Van Keuren Co.

four millionths inch of the exact size, while close to the ends it was correct within three hundred thousandths inch. These gages are made in standard sizes up to ½ inch in diameter. A different handle is provided on larger sizes.

TOLEDO DOUBLE-SCREW PRESS

To meet the demand for a screw press of sufficient capacity to try out blanking, forming, drawing, stamping, and other dies for sheet metal, which are too large for the ordinary single-screw press, the Toledo Machine & Tool Co., Toledo, Ohio, has designed and built the large double-screw press shown in the accompanying illustration. The frame is of the four-piece tie-rod construction, which is a design commonly employed for presses to be used under heavy stresses. The machine is equipped with two 4-inch diameter screws, and the bed is arranged with a powerful spring-pressure drawing attachment intended for use in trying out combination and deep forming dies. Some of the principal dimensions of the press are as follows: Top of bed, 30 by 54 inches; opening in bed, 20 by 48 inches; slide face, 24 by 49 inches; minimum height of slide from top of bed, 14½ inches; maximum height, 32½ inches; thickness of bolster plate, 2½ inches. The weight is about 14,000 pounds.



Double-screw Press designed and built by the Toledo Machine & Tool Co.

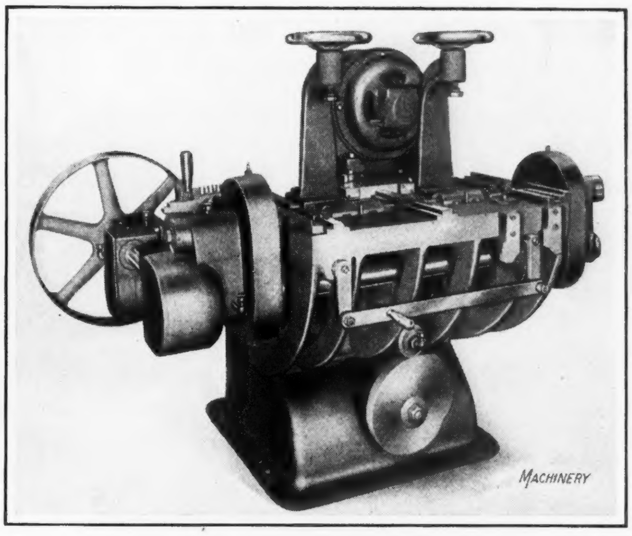


Fig. 1. Special Type of Straddle-milling Machine built by the Newton Machine Tool Works, Inc.

NEWTON SPECIAL STRADDLE-MILLING MACHINE

A special type of straddle-milling machine for facing the crankshaft bearings of crankcases with the caps removed, and at the same time milling the oil slinger groove, has been developed by the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. This machine is shown in Fig. 1 unloaded, while Fig. 2 shows a crankcase being machined and a completed one lying at the base of the machine; in the latter illustration, the motor is not in place. The table is raised and lowered successively when the machine is in operation, being actuated by a cam provided with a slow feed and a quick return as on the machine in Fig. 1, or by an eccentric crank as in Fig. 2. Loading and unloading of the work is done at the top of the stroke, at which time it is intended that the table will be in line with a conveyor system.

The table is provided with hardened steel jig plates and with locating pins that are raised and lowered by means of the lever shown extending across the front of the machine. As a result of this arrangement, there are no obstructions preventing the free mounting and removing of work. The crankcase is clamped in place through the use of two overhead clamps which are operated by handwheels. The cutter mandrel is driven from both ends, and is adequately supported between cutters by bearings.

Eight cutters are required for milling the crankcase shown in Fig. 2, three bearings being faced on both sides,

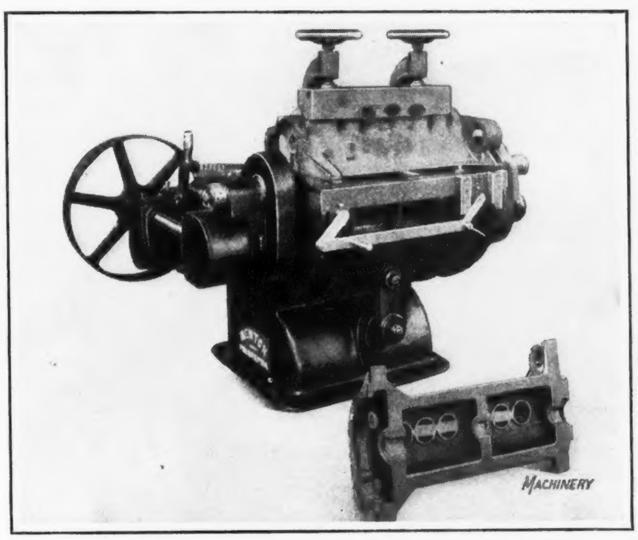
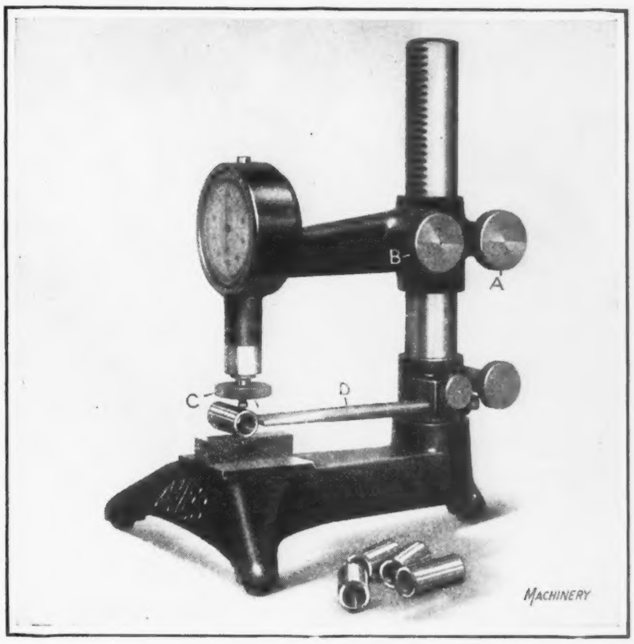


Fig. 2. Machine in Use straddle-milling the Crankshaft Bearing Faces and Oil Slinger Groove of a Crankcase

thus requiring six cutters; another cutter is necessary for machining the oil slinger groove; and a small cutter is provided for finishing the bore of this groove. The production obtained on this operation is twenty-five pieces per hour. Spacing collars giving a variation of 0.002 inch are provided for holding sets of cutters the proper distance apart. Provision is also made so that the rate of feed or the time consumed by the cycle of one operation may be increased or decreased, according to whether the machine is being used on cast iron or aluminum. A larger machine of the same general construction is built for performing an identical operation on crankcases without removing the bearing caps.

AMES DIAL COMPARATOR

The B. C. Ames Co., Waltham, Mass., has added a dial comparator to its line of dial gages, which is intended for use in measuring bushings, pins, shafts, plates, and other parts ordinarily checked by micrometers. With this instrument the personal element does not enter into the operation, as the gage is controlled by a spring. All parts are protected from dust, and all bearings are hardened and



Dial Comparator developed by the B. C. Ames Co.

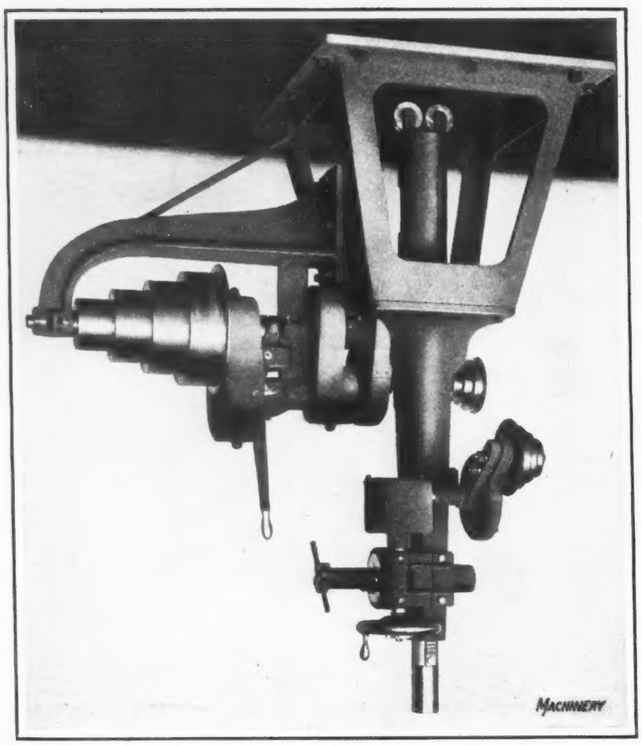
ground. The dial of the gage is 1⅞ inches in diameter and is graduated to 0.0005 inch, each graduation space being 1/16 inch wide, and so readings of one-quarter of a thousandth inch can readily be approximated. In using this gage the knurled handle *A* of a clamping screw is loosened, and the arm supporting the dial is raised or lowered by rotating the knurled head *B* which is mounted on a pinion shaft, until the contact point of the gage touches the work or a standard placed on the anvil.

The clamp is then tightened and the indicator of the gage brought to zero by turning the knurled screw *C* either to the right or left. The gaging point has a travel of ¼ inch, so that although the instrument is set to a 0.500-inch standard, it will measure from that dimension to 0.750 inch. This feature makes it useful for the measuring of parts of more than one diameter. A stop *D* is furnished to permit the rotation of work under the contact point in order to ascertain the amount that a part is out of round, etc. Two hardened and ground anvils are furnished with each gage, one of them being ½ inch wide by 2 inches long, while the other is 2 inches square and grooved. Special anvils can readily be made to fit the groove in the base. The comparator is 10½ inches high and weighs 10 pounds.

REED-PRENTICE SUSPENSION DRILLING MACHINE

An unusual departure in drilling machine design has been made in the machine here illustrated, which is a development of the Reed-Prentice Co., 677 Cambridge St., Worcester, Mass. The machine is intended to be suspended from a ceiling or overhead beams. Its peculiar field is the drilling of work of cumbersome size, and so it is used extensively by manufacturers of electrical equipment for the drilling of switchboard slates, and in boiler shops and sheet metal works. The frame is sufficiently rigid so that no truss rods are required for its support.

The spindle is counterbalanced and is provided with power feed and a quick-return movement. Three feed changes are furnished regularly; but, if desired, change-gears may be supplied to give any required rate of feed. The lever for operating the back-gears can be furnished in any desired length. A countershaft is provided in addition to the equipment shown in the illustration. The machine has a capacity for drilling holes up to about 2 inches in diameter in



Ceiling Drilling Machine developed by the Reed-Prentice Co.

cast iron. The spindle is provided with a No. 4 Morse taper hole. The vertical traverse of the spindle is 19 inches, and the distance from the ceiling to the lower end of the spindle, when it is at its maximum height, is 68 inches. The weight of the machine is approximately 1800 pounds.

UNIVERSAL THREAD MILLING AND GRINDING MACHINE

The universal thread miller and grinder here illustrated was recently developed by the Automatic Machinery & Equipment Co., 1110 Land Title Bldg., Philadelphia, Pa., for milling and grinding worms and threads. It can also be used for milling, fluting, and grinding taps in one setting, for cutting gears and ratchets, for splining shafts, etc. The entire mechanism is mounted on a cast-iron tilting base which is mounted on another cast-iron base that may be attached to the cross-slide of a lathe as shown. A constant-speed motor of 1724 revolutions per minute is mounted directly on the tilting base and is connected to the main driving shaft through sliding helical gears of combinations permitting grinding wheel speeds of 6900 revolutions per minute for internal grinding, and 1725 revolutions per minute for external grinding, and thread milling cutter speeds of 86 and 344 revolutions per minute.

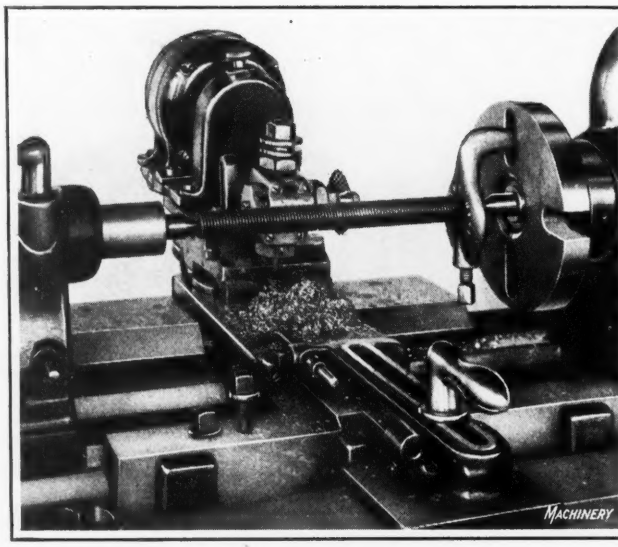


Fig. 1. Thread Milling and Grinding Machine produced by the Automatic Machinery & Equipment Co.

The cutter-head carries two spindles at right angles to each other. When one is held in a horizontal position, the other is in a vertical position. One of these spindles is intended for carrying the grinding wheels, while the thread milling cutters are mounted on the other. The grinding wheel spindle is so arranged that a wheel may be carried on either end, thus making it possible to come close to a shoulder without interference. A cutter can also be carried on either end of the thread milling cutter spindle. The cutter-head swivels through an arc of 360 degrees to permit either of the spindles to be brought into the working position and to provide for tilting the head to suit the helix angle of the thread being ground or milled. Fig. 1 shows a thread being milled, while Fig. 2 shows a thread being ground. An extension spindle is provided for the accomplishment of internal grinding operations.

The cutter-head is of compact design, the grinding spindle being driven from the driving shaft by a pair of tool-steel miter gears. The grinding spindle, in turn, has a tool-steel single-pitch worm which engages a tool-steel worm-wheel on the thread milling cutter spindle and rotates the latter. The cutter-head contains five thrust bearings, two for both the grinding wheel and milling cutter spindles and one on the driving shaft behind the miter gear. The grinding wheel and milling cutter spindles are supported by bronze

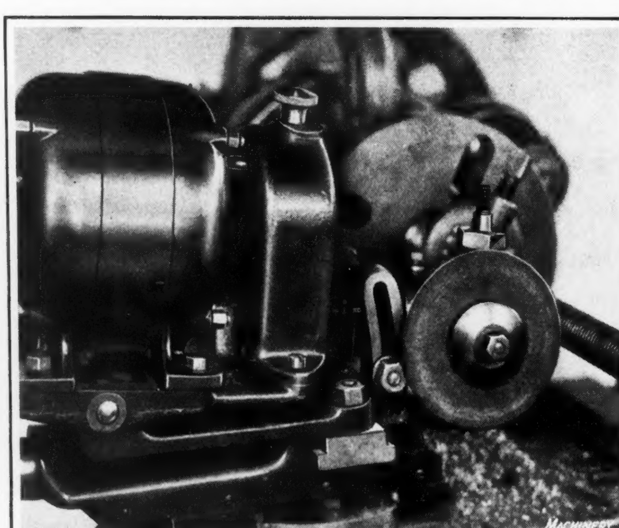


Fig. 2. Device being used for grinding a Threaded Part, the Milling Cutter Spindle being in a Vertical Position

split taper bearings which can be adjusted for wear. The cutter-head is filled with oil for lubricating the gears and bearings. The driving motor may be furnished to suit any current; normally, a 1/6-horsepower motor is furnished, but the base will accommodate a ¼-horsepower motor if such a size is desired. A diamond truing device is furnished for dressing the grinding wheel to any desired angle. The entire equipment measures 8 inches in height, 6 inches in width, and 14½ inches in length. The weight is about 45 pounds.

JACOBS DRILL CHUCK

Improvements that are said to have greatly increased the efficiency have been made on what is known as the "Super" drill chuck produced by the Jacobs Mfg. Co., Hartford, Conn. While the outward appearance of this improved chuck is quite similar to that of the old design, as will be apparent to users by reference to Fig. 1, it will be seen from Fig. 2 that the internal construction is considerably different. Body *A* is made from a steel of special analysis and deeply casehardened through a process in which the taper hole *B* is left soft, thus adapting the chuck for use on a hardened and ground arbor. The threaded plug *C*, placed in the hole tapped through the center of the body, may be easily removed by a screwdriver to permit the insertion of rods, etc., through the chuck.

Fig. 1. "Super" Drill Chuck made by the Jacobs Mfg. Co.

A ball bearing inserted between nut *D* and the body reduces the friction between these members to a minimum, and makes it possible to provide a coarser pitch thread on the nut and jaws than was previously used. The reduction of friction between the nut and body also makes it possible to tighten the chuck with greater ease than formerly, and so considerably lessens the wear of keys, sleeves, and other parts. An oil-hole provided in the back end of the body permits the lubrication of all working parts. It is said that an actual test has shown that on the new chuck the pressure required on the key in tightening the chuck to produce the same results as in chucks of the previous design, is only one-half of that formerly necessary. The change in the pitch of the thread on the jaws and nut has also resulted in reducing to one-half, the number of turns of the sleeve necessary to tighten or loosen the chuck jaws. The weight of a chuck of the improved type is the same as that of one of the original design.

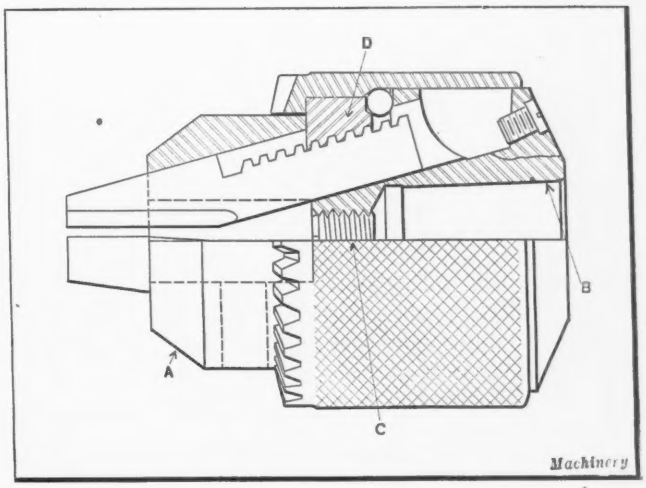


Fig. 2. Construction of Improved Jacobs Chuck

WINFIELD ELECTRIC BUTT WELDER

The accompanying illustration shows an electric butt welder designed for welding high-speed drills, which is a product of the Winfield Electric Welding Machine Co., Warren, Ohio. The construction is such that no flash from the weld can get into moving parts and bearings. One set of four welding dies is furnished with a machine. The lower dies are made of copper and the upper dies of tool steel. They are located at the front of the machine to permit work to be readily placed in them and also to bring the welding point away from the bearings and slides. The work is clamped in the dies by means of hardened steel cams, operated by clamping levers placed well back of the dies and clear of the flash. A single-toggle hand-lever is used for upsetting the weld.

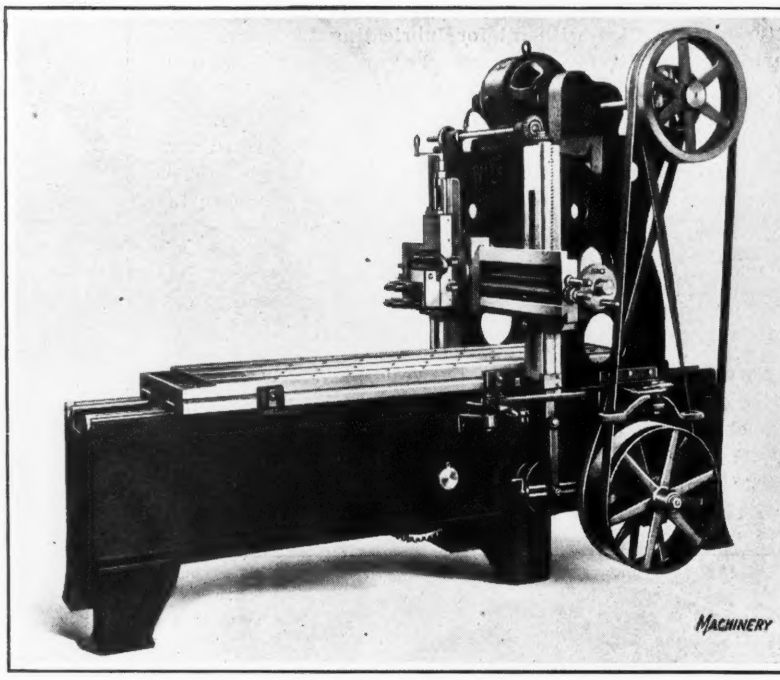
The left-hand slide is adjustable in order to regulate the amount of take-up in welds, and also for aligning the work in all directions. Adjustable stops are provided for backing up the work. The electric switch is located on the hand-lever and operates semi-automatically. It is set by means of a thumb-latch, and is automatically tripped when a weld is completed. Water is circulated through all-copper terminals, and it is unnecessary to break the water connec-

Electric Butt Welder developed by the Winfield Electric Welding Machine Co.

tions when changing dies. The machine has a capacity for welding stock from 1/4 to 3/4 inch in diameter or other shapes having an equivalent cross-sectional area. A 15-kilowatt transformer is part of the equipment. The weight of this butt welder is approximately 1000 pounds.

WILSON PLANER IMPROVEMENTS

A number of improvements have been made to the line of Wilson planers now being manufactured by the Morley Machinery Corporation, 215-217 N. Water St., Rochester, N. Y. The ends of the bed have been squared, and this member has also been strengthened. Additional support has been provided under the uprights, wider bearing surfaces on the cross-rail, steel racks in place of cast-iron ones, and a simple but rugged arrangement for a plain motor drive. A support is furnished on the uprights of all planers, whether the latter are belt- or motor-driven, so that a belt-driven machine may be readily converted to be driven by motor if a customer should so desire.

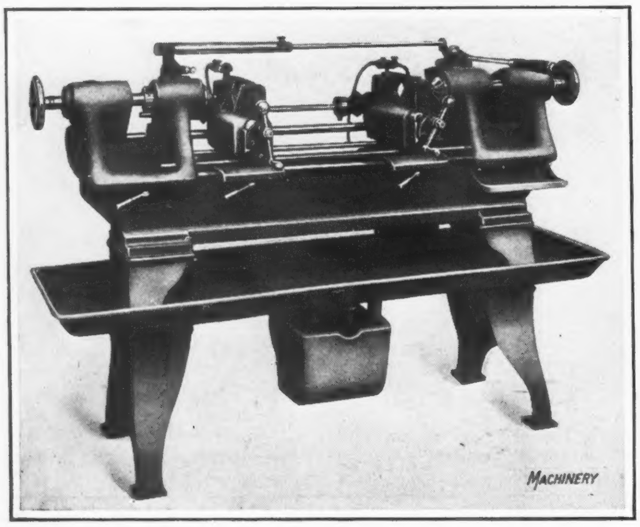


Improved Line of Planers built by the Morley Machinery Corporation

HENDEY DUPLEX CENTERING MACHINE

The Hendey Machine Co., Torrington, Conn., has recently produced the centering machine here illustrated, which is provided with two headstocks and two vises to permit the simultaneous drilling and countersinking of both ends of the work. Each head is driven by a sprocket and chain from a shaft extending the length of the machine at the rear, this shaft being driven from a pulley connected to an overhead countershaft or from a motor bolted to the bed. The driving shaft is supported by sliding pillow-blocks, which furnish the necessary tension on the driving chain.

The rear housing of each headstock is provided with two radial-thrust ball bearings on which the sleeve of the upper of the chain sprockets rotates, the load of the drive being thus taken by these bearings. The front housing carries a sleeve with a taper bearing for the spindle and ball thrusts. The hardened and ground steel jaws of the vise have a total width of grip of 1 1/2 inches. The rear jaw is screwed to the sliding block under spring tension so that the jaw has a floating alignment and insures that the front jaw will be held rigidly in position and govern the aligning of the work with the corresponding drill spindle. The rear jaw serves only as a clamping member. It is stated that the alignment of the jaws is sufficiently accurate to center the work to within 0.001 inch. A motor of 1/2 horsepower is recommended for the machine when a motor drive is desired. The machine can be furnished with beds varying from 5 to 12 feet in length, the maximum distance between spindles of a five-foot bed being 30 inches.



Duplex Centering Machine manufactured by the Hendey Machine Co.

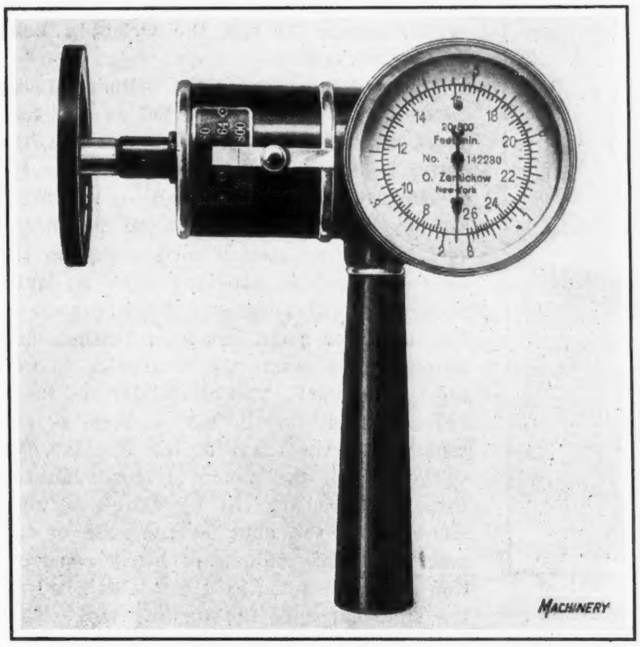
FOSDICK UPRIGHT DRILLING MACHINE

The Fosdick Machine Tool Co., Cincinnati, Ohio, has just placed on the market a heavy-duty upright drilling and tapping machine which has a capacity for drilling to the center of a 21-inch circle. This machine is of similar design to the 25-inch machine described in the September, 1919, number of MACHINERY. On the 21-inch machine, the maximum distance from the base to the spindle is 49 1/2 inches; the maximum distance from the table to the spindle, 33 inches; the spindle traverse, 11 inches; the sliding-head traverse, 22 inches; and the net weight, 2100 pounds. The machine may be built in styles having from two to six spindles for gang drilling.

O-Z CUTMETER

An instrument known as the O-Z cutmeter, intended for determining the cutting speeds of lathes, milling machines, planers, radial and upright drilling machines, etc., and the surface speeds of pulleys, belts, and ropes, is shown in the accompanying illustration. This device has recently been introduced by O. Zernickow, 15 Park Row, New York City. When the instrument is used with a cutmeter wheel attached as shown, surface speeds in feet per minute are indicated direct on the dial without the necessity of timing or making calculations. When a rubber point provided for the purpose is mounted on the instrument, the number of revolutions per minute of a rotating shaft can be obtained. In this way variations in speed can be instantly detected.

The range of the instrument is from 20 to 800 feet per minute and from 30 to 1200 revolutions per minute. There is no vibration of the indicating hand, due to an arrangement which neutralizes shocks and vibration of the part under test. This provision enables easy reading of the cutmeter, even at arm's length. It is claimed that the accuracy of the instrument is not affected by changes in temperature and moisture or by magnetic fields present in

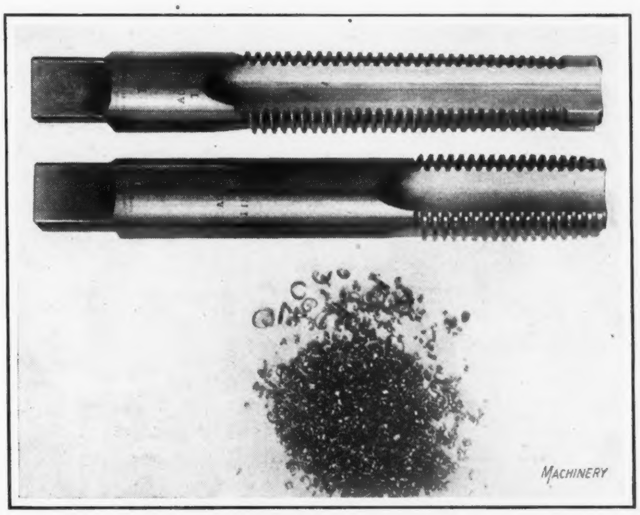


Cutmeter recently introduced by O. Zernickow

shops using electric power, and it may be used in vertical, horizontal, or angular positions. The diameter of the dial is 2⅜ inches; the length of the instrument over all, 5¾ inches; and its net weight, ¾ pound.

BATH "EASY-CUT" GROUND TAPS

A new line of taps for which remarkable cutting qualities and accuracy are claimed has been placed on the market by John Bath & Co., Inc., 8 Grafton St., Worcester, Mass. The illustration shows 1½-inch diameter roughing and finishing Acme taps. It will be seen that the roughing tap at the top of the illustration is provided with a pilot, and that the first few teeth are similar to the U. S. standard, the remainder gradually taking the Acme form. As the pilot centers the tap in a hole and the tap is well tapered, the starting of a tapping operation is easy, and the cutting is distributed over the full length of the tap. Alternate sides of the teeth are relieved, so that only one side of a tooth cuts, thus the teeth have the cutting action of lathe side-tools and roll the chips out easily into the flutes. There is no jamming of chips in the flutes so as to choke the tap, and the breaking of teeth is obviated by the easy cutting action of the tool.

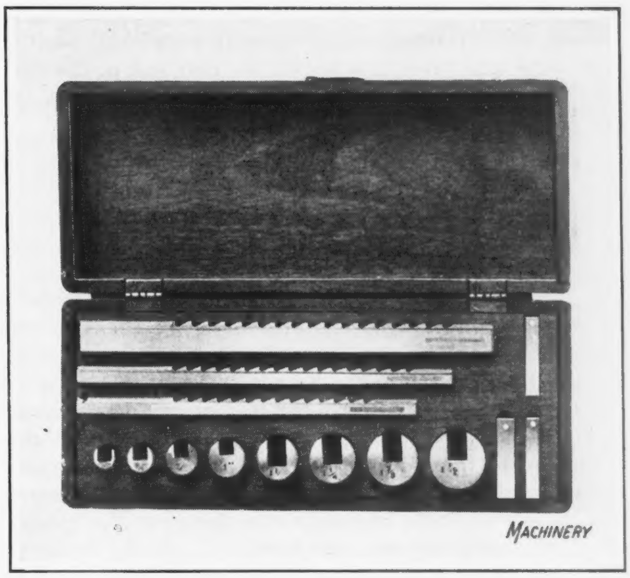


"Easy-cut" Taps placed on the Market by John Bath & Co., Inc.

The finishing tap has the same special relief as the roughing tap, and it is ground in the threads, thus correcting the lead, angle and distortion produced in hardening. The roughing tap cuts out large pieces of metal, while the finishing tap produces long curly chips, the result being a smooth and well finished threaded hole. The "Easy-cut" taps are also made for U. S. standard, S. A. E., Löwenherz, and international threads. The action of a tap for a thread having the sides inclined at an included angle of 60 degrees, is identical to that of an Acme tap, except that the curled chips are smaller. For all ordinary sizes of 60-degree threaded parts, the use of a roughing tap is unnecessary, as the thread may be satisfactorily cut and finished with a single tap.

J. N. LAPOINTE KEYWAY-BROACHING SET

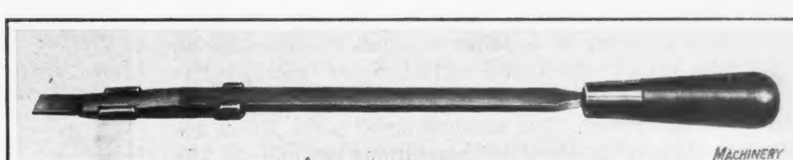
The J. N. Lapointe Co., New London, Conn., has recently placed on the market the combination set of three keyway broaches and eight work bushings shown in the accompanying illustration, which are intended for use in connection with an arbor press for cutting keyways in gears, pulleys, bushings, and other machine parts not manufactured on a quantity production basis. With this set it is possible to cut ⅛-, 3/16-, and ¼-inch keyways in holes ranging from ⅝ to 1½ inches in diameter and lengths up to 2 inches. This set is particularly suitable for use in small shops and garages, and will be found useful by machine tool manufacturers who do not have a sufficient amount of work of this nature to warrant the purchase of a broaching machine and equipment.



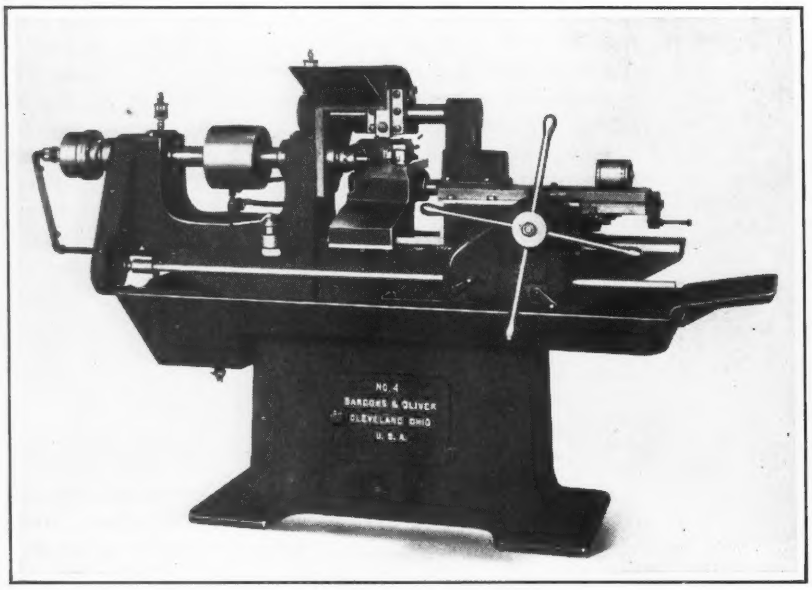
Keyway-broaching Set made by the J. N. Lapointe Co.

ANDERSON HAND SCRAPER

The Anderson Bros. Mfg. Co., 1910 Kishwaukee St., Rockford, Ill., has recently placed on the market the hand scraper here illustrated, which is provided with blades made from the same special steel as those furnished on the Anderson pneumatic scraper. It is claimed that blades made from this special steel have a high degree of hardness, hold an



Hand Scraper made by the Anderson Bros. Mfg. Co.



Piston Turning, Grooving, and Facing Machine built by Bardons & Oliver

exceptionally keen edge, and do not scratch. The clip is notched on the inside to receive and hold the blade positively in place, and there is a lug on the rear end of the blade that prevents it from slipping back. The clip automatically tightens when pressure is applied.

HINCKLEY-MYERS CYLINDER REBORING MILL

A new machine of interest to the automobile trade is the power cylinder reboring mill built by the Dearborn Equipment and Hinckley-Myers Co., 6 N. Michigan Blvd., Chicago, Ill. The top of the base is sufficiently close to the floor to enable one man to readily load an ordinary cylinder block without employing a chain hoist or crane. The slots in the top of the base provide for clamping the cylinder casting securely in position. The cylinders are centered with the work-spindle by means of a device at the extreme left of the parts beneath the base.

This centering device is split and fits around the pilot bar which extends through the spindle and into a bushing in the base. After a cylinder has been centered, the casting may be quickly clamped in position. The pilot bar is lifted and automatically secured in the raised position to permit the loading and unloading of work. The three-blade cutters supplied with the machine are of simple design and easily set for reboring cylinders of any size within their capacity. Each cutter blade is set separately to a gage, and a positive locking device renders it impossible for a blade to slip or change position while an operation is being performed. The "Sizeometer," which is the second of the parts from the left, of those beneath the base, permits the accurate setting of the cutter blades to within one-quarter of a thousandth inch.

BARDONS & OLIVER PISTON-TURNING MACHINE

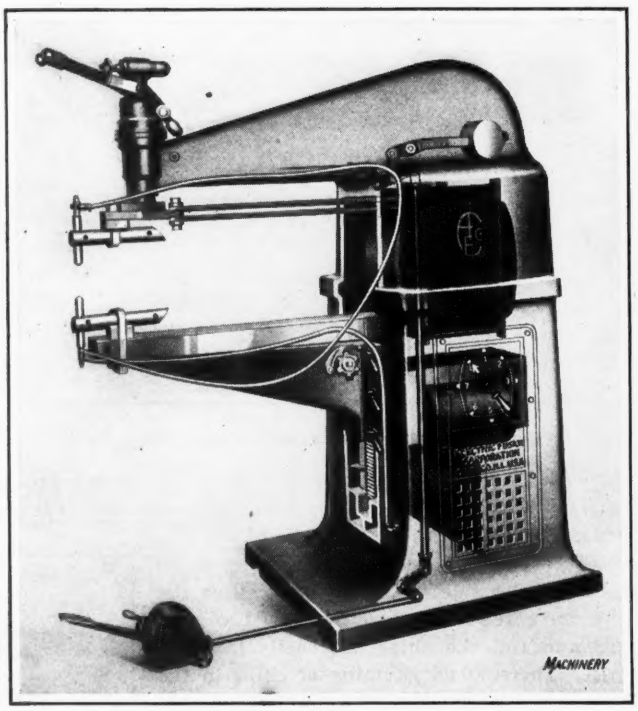
A machine intended for performing operations on aluminum and aluminum-alloy pistons has been developed by Bardons & Oliver, Cleveland, Ohio, and is here illustrated. The spindle is driven by a pulley of small diameter having a face 8 inches wide, so that sufficient power is supplied to enable heavy cuts to be taken while the work is being rotated at a high speed. The nominal speed for a piston 3½ inches in diameter is about 800 revolutions per minute. The spindle is provided with a draw-back chuck for clamping the pistons to the nose of the spindle, this being accomplished by means of an eye-bolt and a pin which passes through the wrist-pin holes of the work.

The tool for turning the cylindrical surface of the piston is carried in the tool-block mounted on the heavy over-arm, the latter being supported on one end by the housing of the machine and on the other end by a slide. The block on which the tool is mounted moves horizontally on the over-arm, and is provided with an automatic trip which causes the withdrawal of the tool after a cut has been finished, and automatically resets the tool prior to taking the next cut. The tool-holder and block are adjustable for the various sizes of pistons within the range of the machine.

The end of the piston is faced and the three grooves are cut by the four tools mounted on the slide at the rear of the machine. This slide is of heavy construction and is actuated by a cam controlled by the slide carrying the turning tool. This cam provides a coarse feed for the facing of the piston end and a fine feed for the cutting of the grooves. An adjustment is provided on the cam so that it may be set for various sizes of pistons. The machine is intended for taking either roughing or finishing cuts. When used for finishing, it is generally provided with an attachment to center the end of the piston preparatory to the grinding operation.

AMERICAN ELECTRIC SPOT-WELDERS

The American Electric Fusion Corporation, 1906 N. Halsted St., Chicago, Ill., has brought out a line of production spot-welders, the various sizes of which have nominal throat depths of 12, 24, 36, and 48 inches. The accompanying illustration shows the 36-inch machine, which has a capacity for welding two pieces of stock up to 5/16 inch in thickness. This welder is equipped with a unique treadle mechanism, which causes the pressure applied on the points to be at a maximum when needed and permits the operator to always be in a comfortable position. These advantages are also present in using the handle provided for hand-operation.



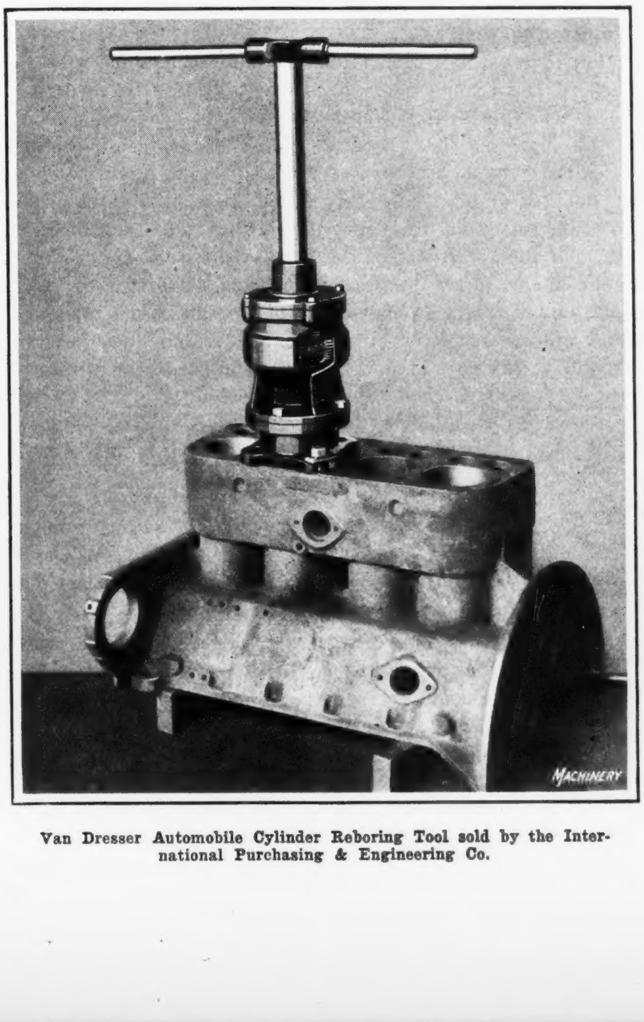
Thirty-six-inch Spot-welder developed by the American Electric Fusion Corporation

The electrode-holders are die-formed pieces of copper, and so eliminate the possibility of joints becoming unsoldered if an operator should neglect to turn on the water circulation. The bolts holding the points to their holders are made of a non-rusting alloy. The machine is of box construction, and all moving and high-voltage current-carrying parts are placed inside for safety purposes. All parts are accessible through panels at the sides and rear of the base. The machine is so designed that all heating at joints is eliminated.

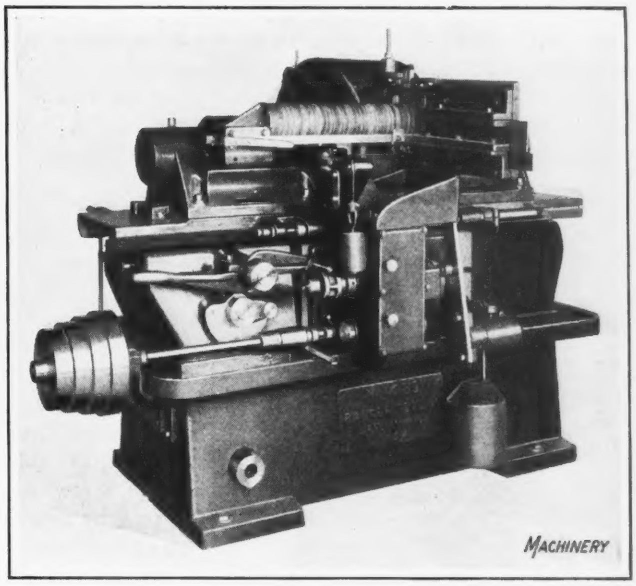
VAN DRESSER CYLINDER REBORING TOOL

The International Purchasing & Engineering Co., 1558 Penobscot Bldg., Detroit, Mich., is the sole sales agent for the Van Dresser automobile cylinder reboring tool shown in the illustration. This tool may be operated by hand through a feed-shaft rotated by the handle attached to the upper end, or by power by removing the handle and connecting the feed-shaft to the spindle of a drilling machine. A feature of interest is that no screw is used for feeding the reamer, the feed-shaft being provided with rack teeth. After the reamer has been fed to the desired depth, the feed-shaft may be lifted or dropped through the cylinder by releasing the feeding mechanism. A floating driving socket is provided when the tool is used with a drilling machine to eliminate any inaccurate finishing of a cylinder due to a misalignment of the reboring tool.

The reamer blades are made of high-speed steel, and are held in a head having a long tapered shank, which is drawn into the socket in the lower end of the feed-shaft by means of a screw. The reamer head does not need to be removed from the feed-shaft in order to adjust the blades. The reboring tool can be instantly removed from the work without disturbing the base, which is centered separately over the cylinder bore. This allows the operator to ascertain the fit of a piston before boring the cylinder completely through, and if another adjustment of the reamer blades is necessary, the reamer will again be placed central with the unfinished bore when it is reinserted.



Van Dresser Automobile Cylinder Reboring Tool sold by the International Purchasing & Engineering Co.



Piston-ring Grinding Machine developed by the Badger Tool Co.

BADGER PISTON-RING GRINDER

The Badger Tool Co., Beloit, Wis., has recently developed and placed on the market the No. 220 automatic piston-ring grinder here illustrated, which has been developed from the No. 220 disk grinder described in the June, 1920, number of MACHINERY. The function of the new machine is to rough-grind the parallel sides of individually cast rings, bringing them down to approximately the desired size preparatory to the performance of the finish-grinding operation on some precision type of machine. The automatic feed of the machine permits high rates of production, and enables one operator to easily handle two machines.

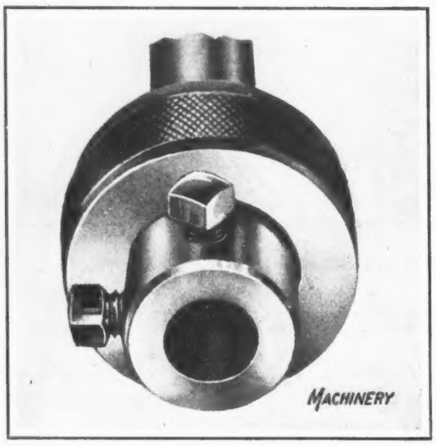
The illustration shows the front view of the grinder with the various hoods and guards removed to enable the construction to be observed. The piston-rings are placed in the hopper track as shown, the track having a capacity for one hundred rings, 3¾ inches in diameter by ¼ inch thick, although the track could be extended to receive two hundred rings, if preferable. The rings in the hopper track are backed up by a pusher attached to a weight by means of a cable, so as to bring the rings successively in front of a reciprocating ram. The latter forces one ring at a time between the two grinding wheels. Bars are provided for guiding the rings past the grinding wheels, these bars being supported at the front and rear of the machine. The grinding wheels are automatically spread apart as a ring enters at the front, a finished ring, at the same time, leaving the grinding wheels at the rear of the machine and falling into a chute which conveys it into a suitable container. The rings pass across the entire grinding face of the wheels, which are 18 inches in diameter.

After a ring has entered the grinding wheels, these are brought together by means of a lever and weights, the force of which may be increased or reduced by adding or removing the weights. A positive micrometer stop screw is located at the front. From installations and tests it has been found that an adjustment is not required more often than once for every 3000 to 4000 rings. However, as in all types of grinding machines, the frequency of compensation for wheel wear is largely dependent upon the kind of wheel used and the amount of metal being removed. A micrometer adjustment must be made following each dressing of the wheels. A throw-out clutch is placed on the driving shaft. The countershaft is provided with an extra cone pulley for driving the automatic parts of the machine, four speeds being available. The countershaft is also furnished with a pulley for driving either a dust-exhauster or a water pump. The machine is adjustable to take rings from 2¾

to 4½ inches in diameter and from ⅛ to ½ inch in thickness. All moving parts, such as gears, cams, rollers, and slides are provided with guards.

RANDA REAMER AND COUNTERBORE HOLDER

The illustration shows a floating reamer and counterbore holder which, it is claimed, will always hold a reamer parallel with the axis of the spindle on the machine on which the tool is being used. This holder has been placed on the market by the Randa Mfg. Co., 1316 E. Jackson St., Muncie, Ind., for use on automatic screw machines, turret lathes, boring mills, and all machines provided with turrets. It may be furnished for any size of reamer shank, either straight or tapered. All wearing surfaces are hardened and ground. Three sizes of holders are regularly carried in stock, the No. 1 having a capacity for holding reamers up to ½ inch in diameter, the No. 2, from ½ to 1⅛ inches in diameter, and the No. 3, for sizes greater than 1⅛ inches in diameter.



Reamer and Counterbore Holder made by the Randa Mfg. Co.

CINCINNATI LEVELING WEDGES

The machine leveling wedges shown in the accompanying illustration, which have been placed on the market by the Cincinnati Engineering Tool Co., Winton Place, Cincinnati, Ohio, were originally developed for use in leveling the tables of planers, but owing to their convenience in making accurate adjustments, they have also been used for the same purpose on other types of machines. In planer installations the wedges are placed on concrete foundations and support the bed of the machine on the sliding member. These slides can be adjusted to the proper height by means of a screw in the base of the wedges. The wedges are furnished in the two styles shown, the one at the right being provided with a lug and an additional screw for obtaining endwise movement of the machine bed. The angular surfaces and the top of the slide are finished, while the adjusting screw is of a fine pitch so as to permit accurate adjustments.

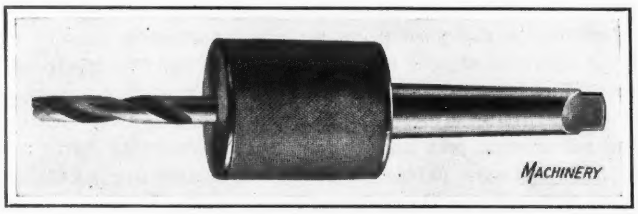


Fig. 1. Automatic Straight-shank Drill Chuck made by the Eastern Tube & Tool Co., Inc.

EASTERN AUTOMATIC DRILL CHUCK

An automatic straight-shank drill chuck enabling an operator to change drills readily while the spindle of the machine is in operation, by simply retarding the rotation of the knurled sleeve of the chuck with one hand and at the same time grasping the drill as it becomes loosened, removing it and then inserting another, has been developed by the Eastern Tube & Tool Co., Inc., 594 Johnson Ave., Brooklyn, N. Y., and is here illustrated. The shank of a drill is held securely in the chuck by means of the three cammed rollers seen in Fig. 2; in this illustration the lower end plate of the chuck has been removed. Pinion teeth are cut on the upper end of each roller, and these mesh with an internal gear on the sleeve. By this arrangement, when the rotation of the sleeve is retarded, the internal gears cause the rollers to revolve and release the pressure of the cam surfaces on the drill shank.

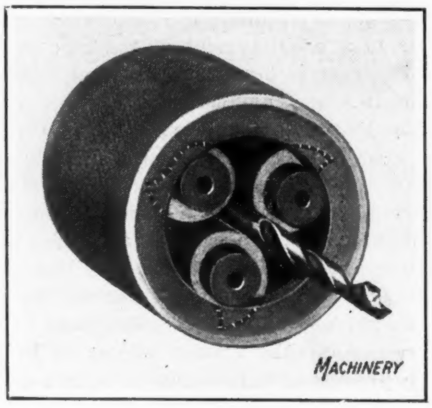
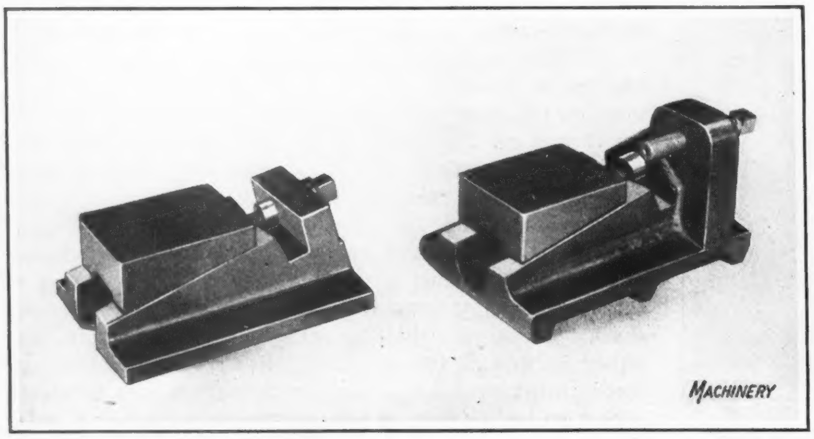


Fig. 2. Chuck Plate removed to show the Three Cammed Rollers

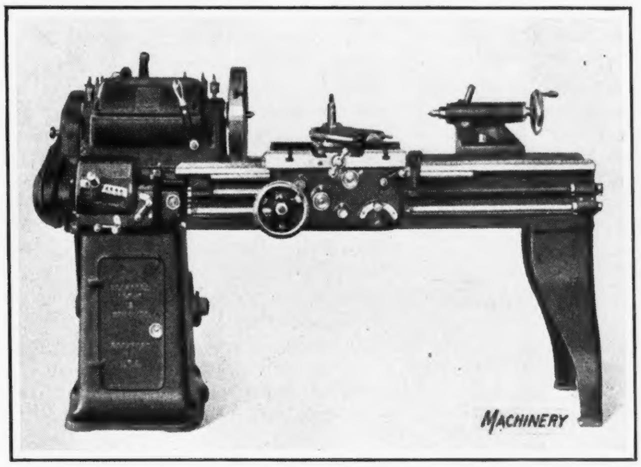
As soon as the chuck sleeve is released, a spiral spring forces the sleeve forward relative to the stationary parts of the chuck, and causes the rollers to be brought against the drill shank. Then when the drill is brought in contact with the work, if the tendency of the drill at first is to revolve in the chuck, this action causes the cams to bear more firmly on the shank so that the drill is held securely. The chuck is regularly made in two sizes, one of which has a capacity for holding drills from ⅛ to 25/64 inch in diameter, and the other for drills ranging from 3/16 to 33/64 inch in diameter. Various sizes of shanks may be provided for a chuck, as the shank is screwed in place, thus permitting a ready replacement when it is desired to use the chuck on a machine provided with a spindle socket which does not correspond to the shank that is in the chuck at the time.



Machine Leveling Wedges made by the Cincinnati Engineering Tool Co.

ROCKFORD GEARED-HEAD LATHE

The "Economy" 14-inch swing, motor-driven geared-head quick-change lathe shown in the accompanying illustration was designed by the Rockford Lathe & Drill Co., 1827 Fourteenth Ave., Rockford, Ill., to serve the purpose of a small heavy-duty lathe. The headstock is driven by a single pulley running at 400 revolutions per minute. The spindle has a 1 5/16-inch hole extending for its entire length. The tailstock is of the offset type, allowing the compound slide to be set parallel with the bed. The tailstock may also be set over for the turning of tapered



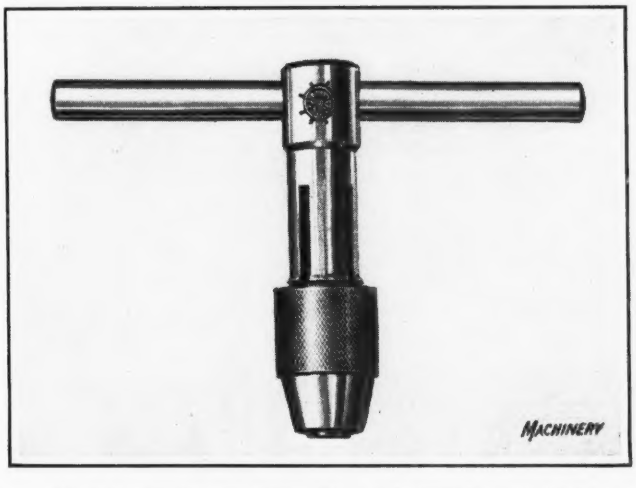
"Economy" 14-inch Geared-head Lathe recently developed by the Rockford Lathe & Drill Co.

parts. The tailstock spindle is locked by an improved clamp which is of such design that it does not require the barrel to be split.

The carriage has a bearing of 20¼ inches on the ways of the bed and is provided with self-oiling felt wipers for keeping the ways clean and lubricated. A thread-cutting indicator enables the operator to catch the thread on the work no matter what the pitch may be, thus eliminating the necessity of reversing the lathe. The quick-change gear-box furnishes thirty-two changes of threads and feeds, which are obtained through sliding gears and clutches controlled by two convenient handles. A 1½- or 2-horsepower motor of any standard make, using either direct or alternating current, and having a constant speed of not more than 1200 revolutions per minute, is suitable for driving the lathe. The motor is mounted on a detachable plate secured to the base and drives the machine by means of a belt 3 inches wide. The operation of the motor is controlled by a shifter-bar running the full length of the bed. This machine may be furnished with a bed 6, 8, or 10 feet in length, the maximum distance between centers on a 6-foot bed being 37 inches.

ADJUSTABLE TAP WRENCH

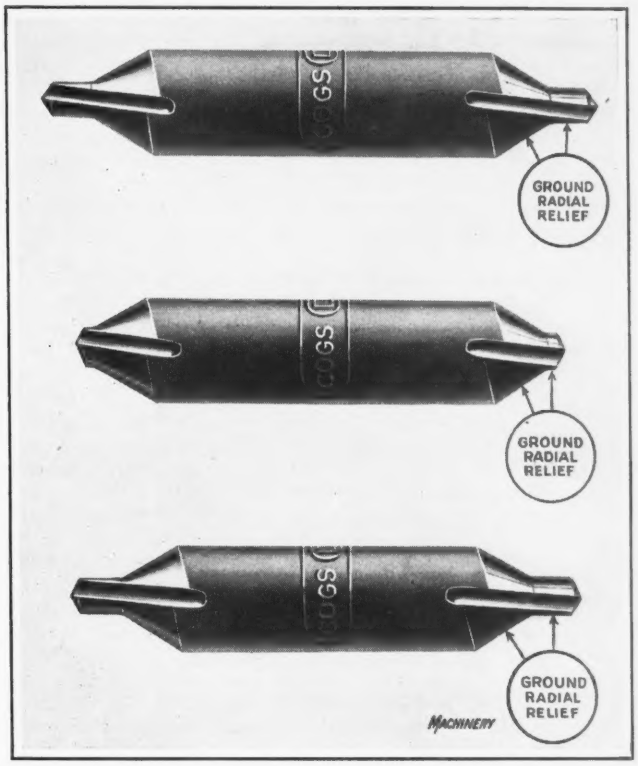
The accompanying illustration shows an adjustable wrench for taps, drills, reamers, and tools of a similar nature, which has recently been placed on the market by the Consolidated Tool Works, Inc., 296 Broadway, New York City. In addition to its use in connection with the tools mentioned, the wrench may also be employed for gripping wire when it is desired to point the ends. The wrench is made from solid bar steel, and is ground and polished.



Adjustable Wrench for Taps, Drills, and Reamers, sold by the Consolidated Tool Works, Inc.

COGSDILL CENTER DRILL

The illustration shows a center drill so constructed as to permit it to be reground after the point has been worn out. This drill is made by the Cogsdill Mfg. Co., 5132 Grand River Ave., Detroit, Mich. It has deeply cut spiral-flute chip chutes which allow the chips to free themselves. The



Center Drill made by the Cogsdill Mfg. Co.

cutting portion of the drill is ground after being hardened, thus, it is claimed, eliminating the breakage commonly due to distortions produced in the hardening process.

NEW MACHINERY AND TOOLS NOTES

Burning-in and Running-in Machine: Detroit Garage Equipment Co., 268 Jefferson Ave., Detroit, Mich. A machine intended for use in service stations, garages, and small motor plants in "burning-in" motor bearings to size and for "running-in" tests.

Bench Drill: Pullman Ventilator & Mfg. Co., York, Pa. A bench drill designed for high-speed work on small parts. This machine will take drills up to and including ⅜ inch in diameter, and the maximum distance from the spindle to the table is 9½ inches.

Cylinder Reboring Attachment: Barnes Drill Co., 814 Chestnut St., Rockford, Ill. A cylinder reboring attachment designed for use in connection with the sliding-extension gap lathe made by this company. The attachment will accommodate any size or type of cylinder.

Forging Furnace with Preheating Oven: Bellevue Industrial Furnace Co., Bellevue Ave., Detroit, Mich. A furnace intended for use in forging high-speed steel drills, reamers, etc. It is provided with a preheating chamber in which the work can be slowly heated before being inserted in the high-temperature chamber.

Truck Platform: Stuebing Truck Co., 312 E. Court St., Cincinnati, Ohio. A portable truck platform made of oak, bound with angle-irons and supported by steel legs with broad bearing surfaces so as not to injure floors. The platform is made in various sizes, and in box, sectional-bin, stake, table, and other types.

Spring Tool-holder: Miner-Fuller Co., Plainville, Conn. A tool-holder which is recessed in the front end to accommodate a section carrying the tool bit, this section being connected to the tool-holder by means of a U-shaped spring. This construction permits the tool to spring back and forth, but all side motion is prevented.

Cutter Grinding Machine: Bilgram Machine Works, 1231 Spring Garden St., Philadelphia, Pa. A machine for grinding the prismatic cutting tools used on Bilgram bevel-gear generators. An abrasive wheel is held on each end of the spindle, one being used for grinding the gear-generator tools, while the other is intended for general purposes.

Carburizing Compound Press: Hanna Engineering Works, 1769 Elston Ave., Chicago, Ill. A machine for pressing plastic carburizing compound about ring gears, the work being placed on the platen and the compound spread on the teeth. After the die is placed on top, the foot-treadle is operated, the result being that the compound becomes packed.

Boring-tool Set: Cascade Tool Co., 71 Washington Ave., Cohoes, N. Y. A line of boring-tool sets which consist of a holder, clamping bolt, two eccentric spring sleeves, and three boring-bars fitted with high-speed steel bits. The offset tool-holder may be swung around so as to enable the operator to turn surfaces which cannot be reached with ordinary tools.

Oil-pump and Agitator: Fruchey Machine Co., 454 E. Lafayette Ave., Detroit, Mich. A soluble-oil pump and agitator, of which the pump proper consists of a rotor running between two blades. The inlet is through five holes in the cover-plate, and the outlet is through a vertical pipe. The agitation is effected by recesses in the veins close to the hub of the rotor.

Annealing Furnace: Bellevue Industrial Furnace Co., 715-717 Bellevue Ave., Detroit, Mich. A semi-muffle type of furnace which can be heated by either oil or gas. It is equipped with a hand-operated chain mechanism for raising or lowering the door. Oil burners are ordinarily used for heating, and these are located at the front where they are easily accessible for adjustment.

Bench and Floor Grinders: Glow Electric Co., 219 Walnut St., Cincinnati, Ohio. A line of totally enclosed electric grinders and polishing stands. The bench grinder is intended for use in assembly rooms and where space is limited, being portable and readily installed. The pedestal grinder is suitable for general shop and tool-room use, while the polishing stand is for general polishing work.

Draw-in Chuck Adapter: Phoenix Tool Co., 2 Remer St., Bridgeport, Conn. A self-contained adapter by means of which spring or draw-in collets may be used in the spindle of any engine lathe or milling machine without employing a draw-bar or providing a through hole in the spindle. The adapter can be used in the dividing head of a milling machine without interfering with the angular setting of the head.

Drilling and Tapping Fixture: Waldon Tool & Metal Mfg. Co., 13 Ferry St., Norwich, Conn. A quick-acting fixture designed primarily for drilling and tapping operations, but which may also be used in hand milling. The jaws for holding the work are operated by a cam-plate so arranged as to give a rapid motion until the jaws are almost in contact with the work, and then to increase the gripping power so as to hold the work firmly.

Storage Battery Tractor: Elwell-Parker Electric Co., 4223 St. Clair Ave., Cleveland, Ohio. A four-wheeled storage battery tractor designed especially to meet the requirements if iron and steel plants. The normal draw-bar pull is rated at 400 pounds while the ultimate power before the wheels slip is given as 2400 pounds. The drive is from a direct-connected motor to a worm reduction on a full floating axle. The weight of the tractor is 4000 pounds.

Milling Machine: Rockford Milling Machine Co., Rockford, Ill. A No. 3 high-power all-geared milling machine on which several improvements have been added since the description presented in MACHINERY for March, 1920. The method of transmitting the feed to the saddle and table mechanism has been changed in such a way as to eliminate the telescopic feed-shaft and universal joints. The over-arm and the feed and speed gear-change mechanism have also been redesigned.

Steam Drop-hammer: Massillon Foundry & Machine Co., Massillon, Ohio. A redesigned line of steam drop-hammers on which the cylinder is a semi-steel casting that connects the tops of the housings, eliminating the necessity of a tie-plate. A safety cylinder is provided to protect the hammer in case the piston-rod becomes broken. The ram guides may be adjusted into the side frames to permit the horizontal removal of the ram. The hammers are built in sizes ranging from 800 to 20,000 pounds capacity.

Wheel-truing Machine: Precision Truing Machine & Tool Co., Cincinnati, Ohio. A wheel truing and dressing machine which may be applied to any surface or tool grinder. A small hard grinding wheel is mounted on one end of the spindle. In use, the device is placed on the table of the grinding machine. Then by bringing the face of the truing wheel in contact with that of the grinding wheel, while the latter is rotating, the truing wheel is also made to revolve, and the action of the two wheels running together dresses the grinding wheel.

Automatic Drilling Machine: Langelier Mfg. Co., 67 Clifford St., Providence, R. I. An automatic machine, which is designed to drill six holes on a door-lock cylinder, but which may, by slight changes, also be adapted for other work. There are six individual spindle units located equidistantly around six-sevenths of a circle, and jigs for holding the work are bolted to a revolving table. There are seven jigs, so as to permit the work to be unloaded and loaded as each jig successively reaches the station above which there is no spindle.

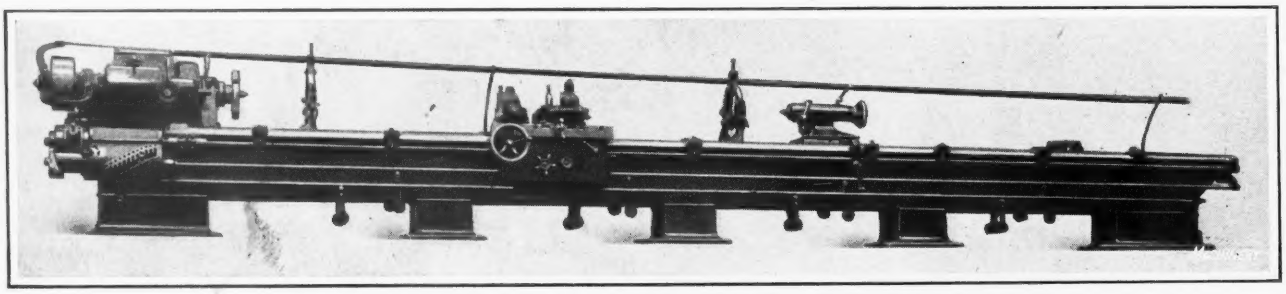
Inverted Multiple-spindle Drilling Machine: Defiance Machine Works, Defiance, Ohio. A line of inverted multiple-spindle drilling machines suitable for deep-hole drilling because of the chip clearance obtained when the drills are in an inverted position, and for drilling work which can be more conveniently held when placed on the face that is to be drilled. The spindle housing is stationary, while the work is mounted on a movable head which lowers the work on the drills. The drill spindles are equipped with collets which may be individually adjusted to compensate for uneven grinding of the drills in a set.

Vertical Lathe: Cadillac Tool Co., 268 Jefferson St., Detroit, Mich. A semi-automatic vertical lathe provided with two carriages, which has been developed to reduce the floor space generally occupied by lathes of the horizontal type. The two carriages are mounted on sliding bars that extend from the base through the tailstock. A carriage is fed by sliding its corresponding bar downward. The right-hand carriage is generally used for turning operations and the left-hand carriage for facing and grooving operations. However, both may be arranged for turning, and they may be fed in the same direction or in opposite directions. The machine is particularly adapted for machining pistons. It has a maximum distance between centers of 16 inches and a swing over each carriage of 9 inches.

* * *

HENDEY LATHE OF UNUSUAL SIZE

In the accompanying illustration there is shown a 24-inch geared-head lathe with a 30-foot bed, which was recently built in the shops of the Hendey Machine Co., Torrington, Conn. The point of especial interest in the construction of this machine is the fact that the bed was cast in one piece. Obviously this was a difficult foundry job, calling for the greatest care in molding and in pouring the metal, to produce a perfectly sound and straight casting of this length, where the width and depth are so much smaller.



Hendey 24-inch Geared-head Lathe with a 30-foot Bed that was cast in One Piece

NEW BOOK ON SOLUTION OF TRIANGLES

SOLUTION OF TRIANGLES. By Erik Oberg. 100 pages, 6 by 9 inches; 44 illustrations. Published by THE INDUSTRIAL PRESS, 140-148 Lafayette St., New York City. Price, $1.

This book is intended primarily for men in machine shops, tool-rooms, and drafting-rooms, requiring a condensed treatise covering the use of formulas and the solution of triangles. Problems involving right-angled triangles are so numerous, and a knowledge of their solution is of such value to the average man in the mechanical field, that a book dealing specifically with the more important problems of the kind mentioned, will doubtless be of direct assistance to a great many whose experience and training has been chiefly along practical lines.

The use of formulas is dealt with in the first chapter in view of the fact that many shopmen do not understand the value of formulas and have erroneous ideas regarding the difficulties of applying them to practical problems. In dealing with the solution of various problems involving right-angled and oblique-angled triangles, examples have been selected to cover cases likely to arise in connection with ordinary work. The presentation of complex trigonometrical problems has been avoided, since the primary object of this treatise is to give the student a good working knowledge of those branches of trigonometry which are the most frequently employed in everyday shop and drafting-room practice.

* * *

PERSONALS

FRED W. CEDARLEAF, formerly chief engineer of the Sparks-Withington Co., Jackson, Mich., has joined the Zeigler Mfg. Co. of Alexandria, Ind., manufacturer of sheet-metal stampings and automatic screw machine products, in the capacity of works manager.

FRANK C. WHITNEY has resigned as advertising manager for the Davis-Bournonville Co., Jersey City, N. J., after eleven years service with the company in the oxy-acetylene welding and cutting apparatus field. He was sales manager during the years 1914 to 1920.

C. F. HERINGTON, who has been connected for the last five years with the Bonnot Co. as mechanical engineer and district sales manager in Chicago, Ill., became associated on May 1 with the Holbeck Engineering Co., Cleveland, Ohio, in the capacity of vice-president.

VICTOR T. GOGGIN, formerly New England sales manager of Fred T. Ley & Co., Inc., of Springfield, Boston, and New York, has associated himself as contracting engineer with Dwight P. Robinson & Co., Inc., of New York, Chicago, Dallas, Youngstown, Los Angeles, and Montreal.

ARTHUR B. SONNEBORN, formerly connected with the Detroit Electric Welder Co. and with the Federal Machine & Welder Co. as sales and service representative in the Detroit and Cleveland territories, is now identified as director of sales with the American Electric Fusion Corporation, 1906 N. Halsted St., Chicago, Ill.

L. F. NIELSEN, formerly chief engineer of the Shaw-Enochs Tractor Co., has engaged in private practice in the field of machine and tool designing and production engineering, in partnership with W. C. Joubert under the name of Equitable Engineering Co. at 101-103 First Ave. N., Minneapolis, Minn. This firm is also manufacturing the Joubert water circulating pump for Ford cars.

RUSSELL B. REID who has been associated for several years with the Edward R. Ladew Co. as assistant sales manager, has been made manager of sales for the Sharon Pressed Steel Co. of Sharon, Pa., manufacturer of motor car frames, industrial trucks, and pressed steel automobile parts. Mr. Reid will direct the sales of the company from the New York office at 66 Broadway.

W. C. PETERSON, who has been associated for the last twelve years with the Packard Motor Car Co., Detroit, Mich., has been placed in charge of the metallurgical department of the Atlas Crucible Steel Co., at Dunkirk, N. Y. During Mr. Peterson's term of service with the Packard Motor Car Co., he had charge of the metallurgical laboratories, heat-treating departments, and research work, and will now take up similar work in the Atlas plant.

EDMUND J. HENKE, who has been connected for a number of years with the electric welding industry in this country and abroad, recently serving as chief engineer of the Thomson Electric Welding Co., and also having been associated with the Federal Machine & Welder Co., has recently organized a new corporation known as the American Electric Fusion Corporation, located in Chicago, Ill. Mr. Henke is president and general manager of the new concern.

F. W. McINTYRE has been appointed general sales manager of the Reed-Prentice Co., Becker Milling Machine Co., and the Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass., succeeding J. P. ILSLEY who has become associated with the Taylor Steel Construction Co., of New York City. Direct sales offices of the three companies are maintained in New York, Detroit, Cleveland, Indianapolis, and Worcester. The Dale Machinery Co., has been appointed sales agent in the Chicago territory, and Normoyle & Lapp, 514 Liberty Bldg., Philadelphia, Pa., have been appointed sales agents in the Philadelphia territory. Improvements in the present product and in new lines are being developed.

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OBITUARIES

LESTER GRAY FRENCH

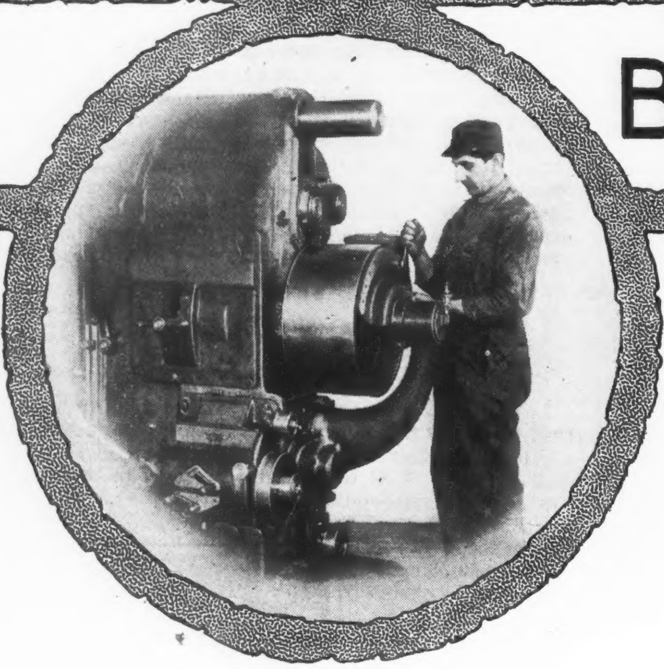
Lester Gray French, for thirteen years editor and assistant secretary of the American Society of Mechanical Engineers, and manager of the journal *Mechanical Engineering*, died on April 18 at the French Hospital in the city of New York from septic poisoning, following an operation. Mr. French was born in Keene, N. H., in April, 1869. He received his technical education at the Massachusetts Institute of Technology, from which he was graduated in 1891 with the degree of S. B. He served the year 1891-1892 with the Cranston Printing Press Co. as draftsman, and then became connected with the International Correspondence Schools, Scranton, Pa., as instructor in mechanical engineering. Leaving this institution in 1895 he went to Providence, R. I., where

he entered the employment of the Builders Iron Foundry as assistant to the superintendent. In 1897 he became editor of MACHINERY, continuing in this position until 1906, when he resigned to take up the publication of technical books, among them being one of the earliest treatises on the steam turbine, of which he was the author. In 1908 he was made editor of the publications of the American Society of Mechanical Engineers, which organization he faithfully and ably served to the date of his death. With a rare combination of enterprise, vision, and dependability Mr. French developed the publications of the society to a very high standard. He had been a member of the American Society of Mechanical Engineers since 1899.

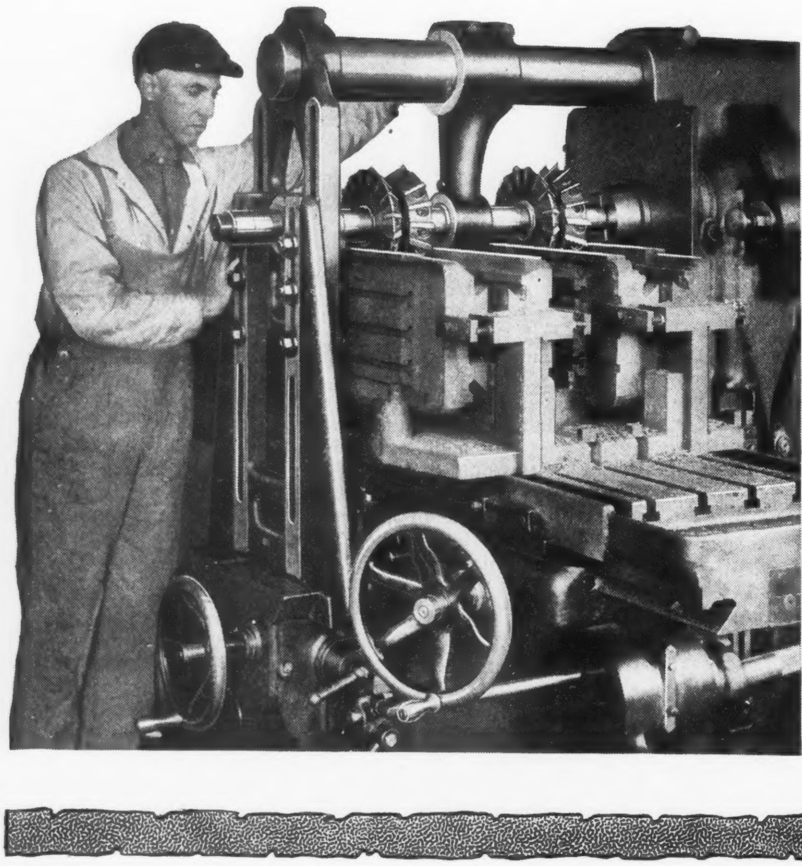
ROBERT ALEXANDER BOLE, vice-president, director, and district sales manager of Manning, Maxwell & Moore, Inc., New York City, died April 2 in the Schenley Hotel, Pittsburg, Pa., where he made his home. Mr. Bole was sixty-two years of age. He was widely known in iron, steel, and railroad circles. Mr. Bole was born in Old Allegheny City and recived his education in the Pittsburg schools. In early life he became identified with the Westinghouse Machine Co., and rose from the ranks to secretary of the company. Following his long and faithful service with the Westinghouse interests, he became identified with the Niles-Bement-Pond Co., and later with Manning, Maxwell & Moore, Inc. At the time of his death he had been connected with the latter company for a period of twenty-six years. Mr. Bole had a wide circle of business and personal friends throughout the East, and his qualities of integrity, justness, and keen business judgment gave him great prominence in manufacturing and civic activities.

L. C. BLANCKE, president and general manager of the Blancke Twist Drill & Tool Co., Inc., and the L. C. Blancke Co., Inc., New York City, died on April 5.

Brown & Sharpe



Power and For Heavy

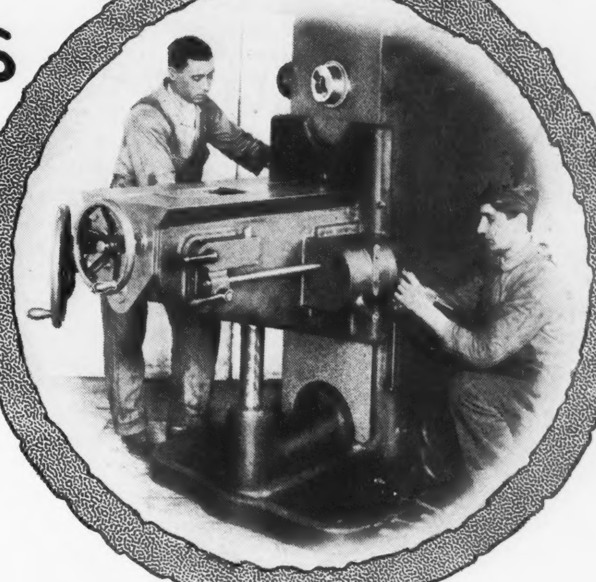


B. & S. Heavy Service Milling Machines possess the power and ruggedness demanded by modern milling practice.

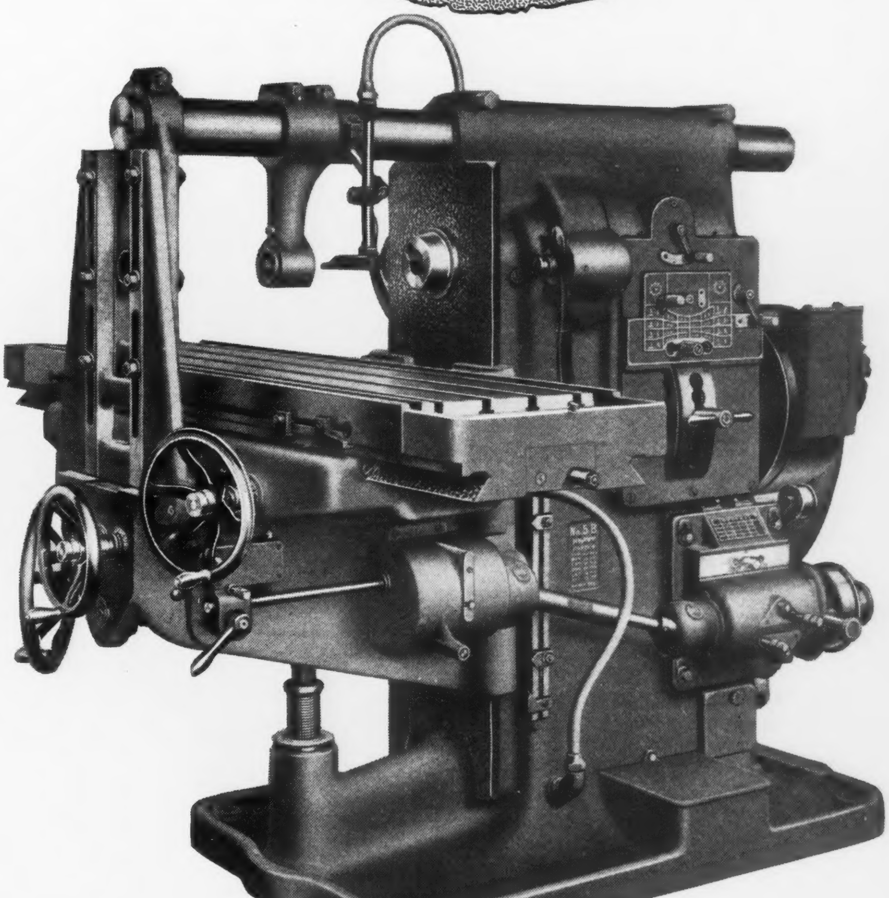
Observe in the above illustration the massive proportions of the driving pulley and the extra wide face—one of the chief elements that provide for a powerful drive, enabling heavy cuts to be taken at high speeds and coarse feeds.

Brown & Sharpe Mfg. Co.,

MILLING MACHINES



Rigidity
Service



Note in the illustration at the right the rigid design of the knee with its ample vertical depth and long bearing surfaces for both column and saddle, also the liberal extension at the top of knee—the point of greatest stress.

These are a few of the numerous features that enter into the construction of B. & S. Heavy Service Milling Machines. There are many others of equal interest described in our Milling Machine Book, a copy of which awaits your request.

PROVIDENCE, R. I.

HOOVER CONFERS WITH TRADE JOURNAL EDITORS

A conference was held at Washington, April 12, between Herbert C. Hoover, Secretary of the Department of Commerce, and a number of the editors of leading engineering and trade journals. At this conference, various topics relating to cooperation between the Department of Commerce and the trade press were discussed, and suggestions were offered as to means whereby the industries of the country could be best served by the Department. Further conferences will be held in the future, and it is believed that in this way the engineering and trade press may form a valuable connecting link between the Department of Commerce and the industries, and may be able to serve their industries better through this cooperation with the Department and especially with the Bureau of Foreign and Domestic Commerce. The object in view is to give whatever aid is possible to the Department of Commerce so that it thereby may be enabled to give to the industries such services as they require.

* * *

MACHINERY CLUB OF BUFFALO

The Machinery Club of Buffalo has been formed among the engineers and sales representatives of the machinery trade of that locality for the purpose of promoting a friendly feeling among the men of the trade. The officers are George T. Aitken, president; Floyd C. Lowell, vice-president; W. B. Joyner, secretary; and A. C. Towne, treasurer. Luncheons are given every week on Saturday at Weyand's Hall, which visiting men are cordially invited to attend.

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NATIONAL MACHINE TOOL BUILDERS' CONVENTION CANCELLED

Announcement is made that the convention of the National Machine Tool Builders' Association, which was to be held in Atlantic City, May 19 and 20, has been cancelled. There will be no spring meeting of the association.

RUSSIAN CONDITIONS AND PROSPECTS

In a letter recently received by a well-known American machine tool builder from the company's former agent in Russia, the following impressions of Russian conditions and prospects are outlined.

"The condition in which Russia will find itself after the Bolshevik regime will be so bad that the re-establishing of the industry will be possible only by the investment of foreign capital to renew and rebuild everything. When the moment for usual trade possibilities will appear no one can tell at present. The first steps to be taken when Russia reopens will be to feed and dress the people, rehabilitate buildings damaged by the bursting of frozen water pipes, and procure stocks of coal and wood. Nearly all the wooden houses in Petrograd have been pulled down and used for fuel. The railroads are in a terrible state both as regards the permanent way and rolling stock. Well-informed Russians believe that it will take years merely to bring the country into a condition where life can be carried on in a normal way. Where the capital required will be found and who will risk the investment nobody can say. Very long credits will be unavoidable. I am at present on a business trip in Roumania. Here, as well as in other parts of eastern Europe which I have visited several times, everything is dull and the German competition keen, based on very low prices and favorable terms."

* * *

TITAN COLLET CHUCKS

In the description of the Titan quick-change collet chucks and sockets made by the Titan Tool Co., 26th and Holland Sts., Erie, Pa., in the April number of MACHINERY, page 811, an omission was made. It should have been stated that the straight-shank drill chucks are made in two sizes, the smaller having a capacity for drills up to and including 5/16 inch in diameter and the larger having a capacity for drills up to and including ½ inch in diameter. The taper-shank drill chucks are made in sufficient sizes to handle all sizes of taper-shank drills.

COMING EVENTS

May 4-7—Eighth convention of the National Foreign Trade Council in Cleveland, Ohio. Secretary, O. K. Davis, 1 Hanover Square, New York City.

May 9-11—Annual convention of the American Association of Engineers in Buffalo, N. Y. Headquarters of the association, 63 E. Adams St., Chicago, Ill.

May 16-18—Joint convention of the National Supply & Machinery Dealers' Association, the Southern Supply & Machinery Dealers' Association, and the American Supply & Machinery Manufacturers' Association in Atlantic City, N. J.; headquarters, Marlborough-Blenheim Hotel. Secretary, American Supply & Machinery Manufacturers' Association, F. D. Mitchell, 4106 Woolworth Bldg., New York City.

May 23-26—Spring meeting of the American Society of Mechanical Engineers in Chicago, Ill.; headquarters, Congress Hotel. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

May 24-28—Summer meeting of the Society of Automotive Engineers in West Baden, Ind.; headquarters of the society, 29 W. 39th St., New York City.

June 15-16—Annual convention of the American Railroad Association (Section III-Mechanical) at Chicago, Ill.; headquarters, Hotel Drake.

June 22-24—Annual joint convention of the American Drop Forge Association and the Drop Forge Supply Association in Chicago, Ill. Secretary, American Drop Forge Association, E. B. Horne, 1516 Helen Ave., Detroit, Mich.

September 14-16—Annual convention of the National Association of Cost Accountants in Cleveland, Ohio; headquarters, Hotel Cleveland. Secretary's address, 233 Woolworth Bldg., New York City.

September 19-24—Third annual convention and exhibition of the American Society for Steel Treating in Indianapolis, Ind. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

September 28-October 8—New York Electrical Exposition at the 71st Regiment Armory, Park Ave. and 34th St., New York City. For information relating to exhibits, apply to Norman Maul, the Electrical Show Co., 130 E. 15th St., New York City, Room 828.

The sectional meetings of the American Society of Mechanical Engineers for May are as follows: **May 9**—Hartford Branch at the City Club, Hartford, Conn.; **May 19**—San Francisco Section in San Francisco, Cal.; **May 20**—Philadelphia Section on the Hotel Adelphia roof, Philadelphia, Pa.; **May 21**—Atlanta Section in conjunction with the Atlanta section of the American Institute of Electrical Engineers in Atlanta, Ga.

NEW BOOKS AND PAMPHLETS

National Safety Code for the Protection of the Heads and Eyes of Industrial Workers. 64 pages, 5 by 7½ inches. Published by the Department of Commerce, Washington, D. C., as Bureau of Standards Handbook Series No. 2. Price, 10 cents.

This little booklet contains a set of rules designed to give mechanical and optical protection to the eyes of workers in occupations which involve eye hazard. The occupations requiring eye protection are classified; and requirements for each group, operating rules, and specifications for testing protectors are given.

The Modern Motor Truck. By Victor W. Page. 962 pages, 6 by 9 inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $5.

This book treats of the design, construction, commercial application, operation, and repair of motor trucks. It outlines the principles on which trucks of various types operate, and covers the construction and operation of the leading types of gasoline and electric trucks. Explicit instructions are given for the repair and upkeep of every part, and for systematic inspection and lubrication. In addition, data on systematic maintenance and cost system are included. A large number of motor truck and trailer applications are illustrated. The material is written in a non-technical manner, and is offered as a compilation of practical information for truck owners, users, and drivers, rather than as an engineering treatise.

Mechanical World Electrical Pocket Book (1921). 376 pages, 4 by 6 inches. Published by Emmott & Co., Ltd., 65 King St., Manchester, England. Price, 2 shillings, net.

This is the 1921 edition of this well-known electrical pocket book, which contains a collection of electrical engineering notes, rules, tables, and data. Among the important improvements in the present edition is a lengthy section on motor starters and controllers, the previous matter on motor starters having been rewritten and the general treatment considerably extended. The section on transmission conductors and cables has been revised, and a new table of maximum currents introduced. The matter on wiring systems and methods has also been rewritten and extended. Substantial additions have been made to the section on electric heating and cooking, and the matter on electric elevators has been rewritten. A list of principal abbreviations has been included and a number of new illustrations are introduced.

Personnel Relations in Industry. By A. M. Simons. 341 pages, 6 by 9 inches. Published by the Ronald Press Co., 20 Vesey St., New York City. Price, $3.

The author of this book is director of the Personnel Department of the Leffingwell-Ream Co., management engineers, and his deductions are the result of long study and actual personal contact with labor problems. He approaches the problem of industrial relations from an entirely new angle. Although he keeps the worker's point of view constantly in mind, he makes production the criterion of any plan and suggestion. He lays great stress on the influence of the instincts in industry, and gives especial attention to the forms of industrial democracy. Other points treated of are interviewing, mental and trade tests, training, promotions and discharges, welfare work, wage relation, labor turnover, and organization of the personnel department. Labor organization both in Great Britain and America is also discussed.

Broaching Practice. By Edward K. Hammond. 122 pages, 6 by 9 inches; 100 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $1.

For many years, broaching has been employed for cutting keyways and machining holes to a variety of shapes, but this method attracted comparatively little attention until extensive developments began to take place in the machine-building field, especially in connection with the manufacture of automobiles. This treatise covers the three important elements in broaching practice; namely, the broaching machines, the design of the broaches or cutting tools, and the application of the broaching process to commercial work. Examples of broaching were obtained from plants using broaching machines for conducting regular manufacturing operations. Since these examples include many classes of work and represent a great diversity of requirements in regard to size and shape, they not only indicate the possibilities of this process but show just how this efficient method of machining can be applied under different conditions.

Organic Chemistry for the Laboratory. By W. A. Noyes. 293 pages, 6 by 9 inches. Published by the Chemical Publishing Co., Easton, Pa. Price, $3.50.

The purpose of the author in writing this book, which is now in its fourth edition, has been to classify the most important of the laboratory processes of preparing pure compounds, and to illustrate them by concrete examples. Two distinct purposes have been kept in view: The first has been to give the beginner full and accurate directions, and clear theoretical explanations of processes which have been found successful in practical laboratory experience; the second object has been to furnish the more advanced student with a guide which will aid him in selecting processes that are likely to be successful for the preparation of compounds that he may desire to use. The number of preparations given is consequently considerably greater than it would be profitable for the average student to prepare. The discussion of special topics, such as crystallization, filtration, distillation, extraction, etc., has been given in connection with preparations, when their use is required.

Cam Design and Manufacture. By F. B. Jacobs. 121 pages, 6 by 9 inches. Published by the D. Van Nostrand Co., 8 Warren St., New York City. Price, $2.

The subject of cam design and manufacture is of considerable interest in view of the fact that cam movements are among the most useful mechanisms that the machine designer has at his command, as it is by means of such mechanisms that many complicated motions can be laid out and constructed. Much of the material previously published on this subject has been presented from a theoretical rather than from a practical point of view. The present work explains some of the methods that are in actual use for laying out and cutting cams, and describes the types of machines used in cam cutting and grinding. Complicated mathematical formulas have been avoided so that the average man unversed in higher mathematics can readily understand the principles set forth. The material is divided into seven chapters under the following headings: Machine Cam Design; Gas Engine Cam Design; Cam Followers; Master Cams; Machine Work on Cams and Cam Cutters; Cam Cutting; and Cam Grinding.

Employe Training. By John Van Liew Morris. 311 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $3.

The need of adequate training for employes has been increasingly realized by manufacturers during recent years, and various systems of training have been developed in different lines of industry. The present book comprises a study of a number of the education and training departments that have been established by concerns in various lines. The study has been undertaken in order to determine to what extent the manufacturing industry can be relied upon to train its own workers. The investigation has been mainly an inquiry into the programs and organization machinery being utilized in industries along the line of employe training, which has expanded to cover a much wider scope than apprenticeship systems of the past. Thirty-five vocational programs are outlined. The book is divided into five sections as follows: Comprehensive Programs for Apprenticeship and Special Training; Programs Emphasizing Apprenticeship; Programs Emphasizing Special Training; Programs of Primarily Technical Instructions; and General Discussion of Apprentice Training, Training of Technical Men in the Industry, and Special Training.

Cylinder Boring, Reaming and Grinding. By Franklin D. Jones. 110 pages, 6 by 9 inches; 80 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $1.

The object of this book is to deal comprehensively with the different methods, tools, fixtures, and machines used for cylinder work. As the most highly developed cylinder machining methods are found in automobile plants, the equipment and practice of these plants is a special feature of this treatise. In factories producing motors by the thousand, it has been necessary to do the work rapidly as well as accurately, which accounts for many of the interesting tools and machines which have been developed. The problem of tool designers, manufacturers of reamers or cylinder boring machines, and others concerned with efficient methods of finishing motor cylinders, has been to secure not only accurate work, but also maximum production. Since the machines and tools which have been developed for use in automobile plants are exceptionally interesting, this class of equipment and the important variations in practice are described completely. A few examples typical of steam, pump, and compressor cylinder work are included to illustrate the general procedure and some of the different types of tool equipment used.

Electric Welding. By Ethan Viall. 417 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $4.

This book discusses the process of electric welding and the uses and principles of construction of arc welding equipment, as well as its application to repair and to production work. It treats of the use of both the metallic and the carbon electrode processes. Attention is given to the physical properties and metallography of arc-fused steel, automatic arc welding, butt-welding and spot-welding. A large number of examples of actual welding jobs are given, and illustrations and descriptions are presented of the different types of commercial welding machines. The book contains seventeen chapters, and an idea of the scope will be obtained from the following chapter heads: Electric Welding—Historical; Arc Welding Equipment; Different Makes of Arc Welding Sets; Training Arc Welders; Carbon-electrode Arc Welding and Cutting; Arc Welding Procedure; Arc Welding Terms and Symbols; Examples of Arc Welding Jobs; Physical Properties of Arc-fused Steel; Metallography of Arc-fused Steel; Automatic Arc Welding; Butt-welding Machines and Work; Spot-welding Machines and Work; Welding Boiler Tubes by the Electric Resistance Process; Electric Welding of High-speed Steel and Stellite in Tool Manufacture; Electric Seam Welding; and Making Proper Rates for Electric Welding, and the Strength of Welds.

NEW CATALOGUES AND CIRCULARS

Blackmer Rotary Pump Co., Petoskey, Mich. Circular containing illustrations and specifications of Blackmer motor- and belt-driven rotary pumps.

Rockford Lathe & Drill Co., Rockford, Ill. Circular descriptive of the "Economy" 14-inch geared-head quick-change lathe arranged for motor drive.

American Emery Wheel Works, Providence, R. I. Circular containing a list of the machines on which American grinding wheels carried in stock can be used.

Ingersoll Milling Machine Co., Rockford, Ill. Circular showing the Ingersoll reciprocating type continuous milling machine, and typical examples of work for which it is adapted.

Northern Engineering Works, Detroit, Mich. Bulletin 543, illustrating different types of electric hoists, and installations of these hoists, showing their adaptability for a wide variety of service.

Roeper Crane & Hoist Works, Reading, Pa. Catalogue 50 of Roeper electric hoists, containing specifications and tables of capacities, lifts, weights, etc., of the hook suspension and trolley types.

Rupp-Moore Co., Inc., Philadelphia, Pa. Booklet of high-grade crucible tool and electric alloy steels, containing data on uses of the different brands, and heat-treating instructions for each case.

St. Louis Machine Tool Co., 932 Loughborough Ave., St. Louis, Mo. Circulars treating of Arcade molding machines, showing examples of patterns plated by the company, core-boxes, and match plates.

Electric Furnace Co., Alliance, Ohio. Booklet containing a collection of photographs of Baily electric furnaces installed in brass foundries and rolling mills in the United States as well as in foreign countries.

Celite Products Co., 11 Broadway, New York City. Bulletin B-4 descriptive of Celite high-temperature cements for use in setting, facing, and patching firebrick work for all types of furnace construction.

Lyon Metallic Mfg. Co., Aurora, Ill. Circular entitled "Everything in its Place," illustrating metallic factory and office equipment, including metallic shelving, steel bench legs, tool racks, blueprint cabinets, desks, etc.

Pawling & Harnischfeger Co., Milwaukee, Wis. Circular illustrating and describing a new Pawling & Harnischfeger crane cage equipped with front-lever-operated controllers and all-enclosed switchboard and control.

Crouse-Hinds Co., Syracuse, N. Y. Circular illustrating installations of safety switch "Condulets" and safety motor-starting switch "Condulets," as well as plug receptacle housings used in connection with these "Condulets."

Gisholt Machine Co., 9 S. Baldwin St., Madison, Wis. Booklet entitled "Reamers at Work," illustrating the Gisholt solid adjustable manufacturing reamer in use. The circular also gives prices and dimensions of the different sizes.

Rickert-Shafer Co., Erie, Pa. Bulletin 7, descriptive of the construction and principle of operation of Rickert-Shafer collapsible taps, which are made in sizes having capacity for cutting straight threads from 1 inch to 6½ inches in diameter.

High-speed Hammer Co., Inc., Rochester, N. Y. Circular showing the different sizes of high-speed riveting hammers made by this concern ranging from No. 1-AA, with a capacity of 1/64 to 1/16 inch, up to No. 6-B with a capacity of ⅝ inch to 1½ inches.

Hercules Electric Steel Corporation, 137 Lafayette St., New York City. Circular containing information relating to "Gladiator" high-speed steel tool-holder bits, which are carried in sizes of from 3/16 inch square by 1½ inches long, to 1 inch square by 7 inches long.

Manning Abrasive Co., Inc., Troy, N. Y., has published a series of booklets entitled "Reflections of 'Sandy,'" containing information on Manning "Speed-grits," including emery paper, metalite cloth, grinding disks, and other abrasive products, presented in story form.

E. Horton & Son Co., Windsor Locks, Conn. Circular containing price lists of the Ellison hardened body drill chucks formerly manufactured by the American Machine Co., of Hartford, Conn., and which have recently been acquired by the E. Horton & Son Co.

J. C. Glenzer Co., Detroit, Mich. Catalogue 4, entitled "Utility Tools," containing illustrations, dimensions, price lists, and other information relating to the line of interchangeable tools made by this company, which includes counterbores, spot facers, reamers, core drills, countersinks, bushings, sleeves, etc.

Detroit Stamping Co., 3445 W. Fort St., Detroit, Mich. Circular giving tables of dimensions of flat and concentric washers produced in combination dies, gang dies, and round dies. The "Universal" card-holders made by this company, which are carried in four styles are also illustrated in this pamphlet.

Chicago Flexible Shaft Co., 1154 S. Central Ave., Chicago, Ill. Catalogue 80, treating of Stewart porcelain enameling furnaces. Information is given on the characteristics of enamels, ingredients and properties, fluxes, enameling coloring compounds, application of enamel, and requirements and types of furnaces.

Collis Co., Clinton, Iowa. Bulletin descriptive of the "Wonder" quick-change drill chuck, which is provided with collets for holding various kinds of tools. The pamphlet contains price lists of the chucks, collets, and bushings; a list of equipment for use in connection with the "Wonder" chuck; and tables of tap sizes.

Simmons Economy Tool Corporation, 981 Broadway, Albany, N. Y. Circular descriptive of the "Hold-em-all" tool-holders, designed to hold different sizes and shapes of tool bits down to lengths as short as ½ inch in one tool-holder. Price lists and illustrations showing the different types of tools that can be held in one holder are included.

Yale & Towne Mfg. Co., Stamford, Conn. Circular entitled "Make Labor More Efficient," illustrating the use of Yale hoisting and conveying systems. Circular D-2163, containing dimensions and other data relating to Yale spur-geared chain blocks, which are built in seventeen sizes with capacities of from ¼ to 40 tons.

Expanded Metal Safety Guard Co., 14th St. and Vernon Ave., Long Island City, N. Y., is issuing a monthly publication known as the "Safety Guardian," which is descriptive of machine guard installations made by this concern for a variety of classes of machines. The bulletin also contains other information relating to safety.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin 223, illustrating various types of burners suitable for the use of oil and gas fuels for industrial heating. Information is given on conditions governing the selection of burners, as well as methods of attaching burner plates, and prices of different sizes and types of burners are included.

Fulton Iron Works, St. Louis, Mo. Bulletin 801, treating of Fulton Diesel oil engines. A historical sketch of the development of the Diesel engine is given, which is followed by a description of the Diesel cycle of operations, charts showing fuel consumption curves, and information relating to fuel economy and fuel supply, lubrication, etc.

Wayne Machinery Co., Fort Wayne, Ind., manufacturer of woodworking machinery and machine shop and metal-working tools has published a booklet intended to give an idea of what may be seen on a trip through the plant of the company. The book contains photographs of the various departments as well as a description of the equipment, products, etc.

Cleveland Punch & Shear Works Co., Cleveland, Ohio. Circular illustrating Cleveland punching machines which are adapted for the use of

seven standard interchangeable attachments, namely, punching attachment, angle shearing attachment, bar shearing attachment, plate shearing attachment, coping attachment, notching attachment, and flue hole punching attachment.

United States Steel Corporation, Bureau of Safety, Sanitation, and Welfare, 71 Broadway, New York City. Bulletin 8, showing examples of the safety and welfare work carried on in the plants of the United States Steel Corporation. The booklet is made up of photographs illustrating safety equipment, educational and recreation provisions, as well as homes constructed for the employes.

Vanadium-Alloys Steel Co., Latrobe, Pa. Booklet containing sixty-eight pages devoted to "Redcut Superior" high-speed steel. In addition to the information given concerning heat-treatment, uses, etc., the pamphlet lists special sections, and gives tables of weights, and suggestions concerning the grinding of high-speed steel. Copies will be sent upon request to any user of high-speed steel.

Chicago Pneumatic Tool Co., 6 East 44th St., New York City. Bulletin 639, treating of the BQ-46 hammer drill, which is adapted primarily for demolition work, being of use to contractors in demolishing old buildings, concrete walls, and foundations, drilling anchor bolt holes, and work of a similar nature. The tool is also of use in steel mills and glass plants for removing slag from ladles and slag pockets, glass from furnaces, etc.

Simonds Mfg. Co., Fitchburg, Mass. Catalogue 121, entitled "Simonds Steel and Useful Reference Tables," descriptive of this company's facilities for making steel both for Simonds saws and for commercial purposes. In addition to material relating to heat-treatment, and data on the high-speed tool steel, and carbon and special alloy tool steels produced by the company, a large number of useful tables are included giving weights of steel, flash and fire tests of oils, melting points, decimal equivalents, heat colors, temperature conversion tables, etc.

Bacharach Industrial Instrument Co., Bennet St. and Murtland Ave., Pittsburg, Pa. Bulletin G, descriptive of manometers, for the determination of small pressures or pressure differences. These instruments have been recently added to the line of products which this company manufactures. The types shown in the circular are of a new design, and may be arranged either for pressure, draft, or differential pressure. Pamphlet M, descriptive of engine indicators of the Maihak type, which are furnished for revolutions up to 1500 per minute, for application to Diesel engines, automobile engines, airplane engines, etc.

National Acme Co., Cleveland, Ohio. Circular entitled "The Modern Mahomet," announcing moving pictures which have been made by the company in order to give those who do not have an opportunity to go to the National Acme plants, the privilege of actually inspecting their plants through these films. One of the films is entitled "The Spirit of Progress," and constitutes a trip through the screw products plant of the company, showing in detail the various operations involved in the making of a spring bolt. The other film, entitled "Building Gridley Automatics," represents features of the manufacture and assembly of Gridley automatic turret lathes and multiple-spindle screw machines. These films are shipped without charge to any company, society, or school desiring to exhibit them.

Bardons & Oliver, Cleveland, Ohio. Catalogue illustrating and describing a line of standard tools for the Bardons & Oliver turret lathes. The first part of the book gives data on turret and cut-off rest tools, including stop gages, chamfering tools, box-tools, die-holders, threading dies, die-heads, drill-holders, turning tools, tap-holders, recessing tools, hollow mills, knurling tools, cutting-off tool-holders, etc. The second part contains a detailed description of the automatic chuck mechanism used on Bardons & Oliver turret lathes; the third part contains illustrations and names of parts of the machines for use in ordering repairs; and the fourth section is made up of reference tables giving speeds of machines, screw thread data, weights and areas of round, square, and hexagon steel, etc.

TRADE NOTES

Victor Saw Works, Inc., announce the removal of their plant from Springfield, Mass. to Middletown, N. Y.

Michigan Tool Co. moved on April 25 to its new factory and office at 147 Jos. Campau, corner of Atwater St., Detroit, Mich.

Dodge Mfg. Co., Mishawaka, Ind., announces that it has obtained the exclusive agency for the distribution of Kenyon cotton rope in the United States and Canada.

Cadillac Tool Co., Detroit, Mich., announces the removal of the machine tool sales division of the company, together with the accounting department, to a new sales office and sales room at 38 Hendrie St.

Universal Crane Co. has removed its plant from Cleveland, Ohio, to its new factory at Elyria, Ohio. The company has greatly increased its capacity and production is now under way in the new plant.

U. S. Tool Co., Inc., 51-53 Lawrence St., Newark, N. J., will take additional shop space at 117 Mechanic St., where the company will manufacture the U. S. sup-presses, and will do an extensive line of punch press work.

Norton Co., Worcester, Mass., manufacturer of grinding wheels and grinding machines announces that until further notice all refractory materials previously billed at list price, plus 10 per cent, will be billed at the straight list price.

Bernard E. Mohr, formerly manager of the machine tool department of the Fairbanks Co., St. Louis, Mo., has engaged in business for himself at 5407 Easton Ave., St. Louis, Mo., selling new and used machine tools and machine shop equipment.

Consolidated Tool Works, Inc., has moved from 261 Broadway into new quarters at 296 Broadway, New York City, where the general offices and the New York warehouse of the company will be located under one roof, which will greatly facilitate the handling of the business.

Mason, Fenwick & Lawrence, 220 Broadway, New York City, patent and trademark lawyers, announce that they have associated with them three late members of the examining corps of the United States Patent Office, namely, E. D. Sewall, C. R. Allen, and H. P. King.

Edward Valve & Mfg. Co., East Chicago, Ind., has moved its general offices from 72 W. Adams St., Chicago, to its factory at East Chicago, Ind., in order to centralize the control of the industry and better serve its customers. All correspondence should hereafter be addressed to East Chicago.

Pittsburg Stamp Co., Inc., has moved from Pennsylvania Ave., to larger quarters at 815-817 N. Canal St., North Side, Pittsburg, Pa. In the new location the company will have a modern completely equipped factory for turning out steel lettering dies, steel and brass stamps, nameplates, stencils, and similar work.

Sage Radiator Co., Inc., has been organized in Syracuse, N. Y., by Charles S. Sage, for twelve years chief engineer and superintendent of the Rome-Turney Radiator Co. of Rome, N. Y. The new company will manufacture radiators for trucks, tractors, and airplanes and will be located at 1050 S. Clinton St., Syracuse, beginning May 1.

E. Horton & Son Co., Windsor Locks, Conn., has taken over the Ellison drill chuck business, which has been carried on for the last few years by the American Machine Co., of Hartford, Conn. It is the aim of E. Horton & Son Co., to carry such a complete line of chucks that it will be in a position to supply a chuck for every possible need.

Victor Saw Works, Springfield, Mass., at a meeting of the board of directors, elected William F. Pollock, president of the company to succeed Frank M. Baldwin, resigned, and Guy W. Donahue, vice-president in place of William P. Jeffery. The board of directors was increased to five members by the addition of Mr. Pollock and Mr. Donahue.

Victor Tool Co., Inc., Waynesboro, Pa., has opened a branch office in New York City at 131 W. 39th St. F. W. Curtis is manager and Warren J. Boe is sales engineer. All matters from the New York territory pertaining to the company's line of collapsible taps, self-opening die-heads, and floating reamer-holders will be handled from this office.

Federal Engineering & Mfg. Co., Cleveland, Ohio, has reorganized for the purpose of expanding its business. The company is developing a special line of machine tools and parts, and will continue its regular lines under the name of the Master Tool Co., at its present address 203 E. St. Clair Ave., Cleveland, Ohio. Charles F. Overly is vice-president and general manager.

Wheel Trueing Tool Co., 2131 Penobscot Bldg., Detroit, Mich., importer of industrial diamonds, and manufacturer of diamond-pointed tools, announces the removal of its western office from the Wells Building, Milwaukee, Wis., to the company's branch office in the Great Northern Bldg., 20 Jackson Blvd., W., Chicago, Ill. W. J. Sansom will be in charge at the new location.

David A. Wright, Chicago, Ill., dealer in machine tools and appliances, has moved into new quarters at Jefferson and Monroe Sts. in the new machinery center in Chicago. The new offices have 5000 square feet of floor space and 150 feet of window space, and will be used exclusively for show rooms. Mr. Wright is also putting on the market a line of large lathes of his own manufacture.

Arrow Tool Co., 200 Cannon St., Bridgeport, Conn., announces that the company is now doing business under the name of Arrow Tool & Mfg. Co. There will be no change in the business aside from the addition of a fully equipped press department which will enable orders to be taken for light and medium sheet-metal stampings and light manufacturing. The company will continue to make tools and special machinery of all kinds.

Modern Tool Co., 2nd and State Sts., Erie, Pa., has appointed the E. L. Essley Machinery Co., 551 Washington Blvd., Chicago, Ill., as the exclusive selling agent in the Chicago territory for Modern plain and universal grinding machines. At the Essley headquarters expert services will be given to customers by experienced grinding machine men, and the Modern Tool Co. will also have its own grinding expert stationed there.

David A. Wright, Chicago, Ill., moved May 1 to a new location at the southwest corner of Jefferson and Monroe Sts. The new showroom will have approximately four times the space now occupied. In addition, the company has a warehouse and factory at Roosevelt Road and Washtenaw Ave., where a large stock of machinery is stored and rebuilt. This plant is equipped with machinery for rebuilding machine tools.

Atlas Crucible Steel Co., with plants at Dunkirk, N. Y. and Welland, Ontario, Canada, has moved its general offices, including general sales offices, to the Hanna Bldg., Cleveland, Ohio. The company has recently extended its facilities, and in addition to its regular production of tool steels is now in a position to furnish high-grade alloy steels. Frank P. Case will be in charge of the sale of tool steels, and Harry J. West in charge of the sale of alloy steels.

Austin Machinery Corporation, manufacturer of cranes, steam shovels, and other road-building machinery, announces that it will rebuild its plant at Winthrop Harbor, Ill., which was recently destroyed by fire. For the present business will be handled through its Muskegon plant or Toledo plant. The company has recently consolidated into its group, the plant of the Fairmont Mining Machinery Co., at Fairmont, W. Va., and extensive improvements are planned there.

Ogden R. Adams, Central Ave. and St. Paul St., Rochester, N. Y., will hold a machinery demonstration and hand-hacksawing contest at his plant on the afternoon and evening of May 7. The hacksaw contest will consist of sawing through ten lengths of 1-inch pipe, and an award of $25 in cash will be made to the winner. Demonstrations of drilling, milling, internal and external grinding, and lathe and screw machine work will be made by experts from various machine tool manufacturers, showing latest methods of production.

Darwin & Milner, Inc., makers of crucible and electrically melted carbon and alloy steels, announce that the head offices and warehouses of the company are now centralized at 403 Long Ave., Cleveland, Ohio, to which address all general correspondence and orders should be sent. H. Reinhardt, 80 Rutland Road, Brooklyn, N. Y., will act as general district agent for New York and adjacent territories, and the Brooklyn Steel Treating Corporation, 8 Franklin St., Brooklyn, N. Y., will be special representative of the company for New York City.

American Electric Fusion Corporation was recently organized with a capital of $50,000 for the purpose of manufacturing electric welding machinery of the resistance type, that is, butt-welders, spot-welders and seam-welders. The officers of the corporation are as follows: President, Edmund J. Henke; vice-president, Edgar Littmann; secretary-treasurer, S. G. Taylor, Jr.; director of sales, Arthur B. Sonneborn. The works and offices of the new corporation are temporarily located at 1906 N. Halsted St., Chicago, Ill., pending the erection of a permanent home.

Reeves Pulley Co., Columbus, Ind., has transferred its New York agency from Patterson, Gottfried & Hunter, Inc., to the Standard Supply & Equipment Co., 71 Murray St., New York City. The new agency will carry complete stocks of the Reeves variable-speed transmission and wood split pulleys, as well as a full line of repair and replacement parts. William L. Garcia formerly head of the power transmission department of Patterson, Gottfried & Hunter, will continue to handle the Reeves lines, having now become associated with the Standard Supply & Equipment Co.

Fosdick Machine Tool Co., Cincinnati, Ohio, maker of heavy-duty radial drilling machines and upright drilling machines has taken over all patents, drawings, patterns, jigs, and fixtures covering the line of Pierle quick-change high-speed ball bearing sensitive drilling machines from the R. K. Le Blond Machine Tool Co. This acquisition will give the Fosdick Machine Tool Co. a complete line of drilling machinery consisting of heavy-duty radial drilling machines, heavy-duty upright and gang drilling machines, and high-speed sensitive single- and multiple-spindle drilling machines.

Air Reduction Sales Co., manufacturer of "Airco" oxygen, acetylene, and welding and cutting apparatus, announces that its executive offices were moved on May 1 from 120 Broadway and 160 Fifth Ave., to 342 Madison Ave., New York City. The New York district office was transferred on the same date to the "Airco" factory at 191 Pacific Ave., Jersey City, N. J. The company also announces that it has secured control of the National Carbide Corporation of Virginia, which has a new plant at Ivanhoe, Va., and began May 1 to direct the policy and control the operation and sales of this corporation. The carbide produced at the new plant will be marketed as "Airco" carbide through the chain of "Airco" distributing stations.